TQM Volume-13

Total Quality Management in Factory Management

Taguchi Method

2025a Edition

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Factory Management Institute

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Icons:

Notes: Going back to the central theme.

The third level of the Issue provides more clearness to the structure of the text to the more relevant.

Lower levels of the Issue, commonly 6th or 7th, and, pointing out necessary explanations about pictures or graphs.

UPDATING TABLE:

Date, Version-Previous & V-Next	Chapter (I..XX...)	Chapter Point.- sub-point : (Updating)

TQM-13 Video Summary in English. LinkedIn publication by the Factory Management Institute:

https://www.linkedin.com/posts/factory-management-institute_lean-tps-tqm-activity-7384250532003119104-ypaF/?utm_source=share&utm_medium=member_desktop&rcm=ACoAAAV2n70B7jTxvXCo1iOEoY3hJXgVoXyucis

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SUMMARY[1] [eng]

Volume 13 of TQM, written by Kouichi Kimura, addresses crucial topics in quality and production management. In quality, the Taguchi Method (Design of Experiments/DOE) is discussed, fundamental to achieving "quality by design" through the use of orthogonal arrays and the Signal-to-Noise (SN) ratio. Although traditionally difficult to use, supporting tools such as Minitab and Qualitek-4 now facilitate its implementation. It is postulated that Artificial Intelligence (AI) will not replace Taguchi, but rather incorporate and evolve from its robustness engineering principles.

The volume assesses a financial crisis at a factory (Jishu-Ken Group) seeking to introduce the Toyota Production System (TPS) to eliminate inventory, identified as the "root of all evil." The consultant warns that implementing JIT/TPS is unfeasible because the company is a "Jellyfish Company" (JFC). It lacks a "corporate backbone" (Strategy, Annual Policy, and Action Plan), and its Factory Management is very low (45%), requiring a solid foundation (>75%) before attempting advanced systems. TPS as a holistic cultural system (based on JIT and Jidouka) is contrasted with Lean, a Westernized, tool-centric approach.

TQM-13 Resumen de Audio generado con Notebook LM (Google Drive mp4 file)

Appendix A, by Eduardo L. García, details the use of the KJ Method to develop Potential Problem Maps (PPMs) assisted by an "AI-colleague." The use of AI helps generate and prioritize root cause hypotheses, demonstrating great accuracy in designing experiments.

RESUMEN[2] [esp]

El Volumen 13 de TQM, escrito por Kouichi Kimura, aborda temas cruciales de gestión de calidad y producción. En calidad, se discute el Método Taguchi (Diseño de Experimentos/DOE), fundamental para lograr la "calidad por diseño" mediante el uso de arrays ortogonales y la relación Señal/Ruido (SN). Aunque su uso era tradicionalmente difícil, herramientas de soporte como Minitab y Qualitek-4 ahora facilitan su implementación. Se postula que la Inteligencia Artificial (IA) no reemplazará a Taguchi, sino que incorporará y evolucionará a partir de sus principios de ingeniería de robustez.

La entrega evalúa una crisis financiera en una fábrica (grupo Jishu-Ken) que busca introducir el Sistema de Producción Toyota (TPS) para eliminar el inventario, identificado como la "raíz de todo mal". El consultor advierte que la implementación de JIT/TPS es inviable porque la empresa es una "Jellyfish Company" (JFC). Carece de la "columna vertebral corporativa" (Estrategia, Política Anual y Plan de Acción), y su Gestión de Fábrica es muy baja (45%), necesitando una base sólida (>75%) antes de intentar sistemas avanzados. Se contrasta el TPS como un sistema cultural holístico (basado en JIT y Jidouka) frente al Lean, un enfoque occidentalizado centrado en herramientas.

TQM-13 Resumen de Audio generado por Notebook-LM (Google Drive mp4 file)

El Anexo A, por Eduardo L. García, detalla el uso del Método KJ para desarrollar Mapas de Problemas Potenciales (PPM) asistido por una "AI-colleague". El uso de la IA ayuda a generar y priorizar hipótesis de causas raíz, demostrando gran precisión al diseñar experimentos.

[1] Audio summary in English: https://drive.google.com/file/d/19qxn8LYOTQhLJ-FtuGmLTFdWSyauOnRW/view?usp=sharing

[2] Resumen de Audio en español: https://drive.google.com/file/d/1HBgMpT2GCa5HaX7KqB_mdw04I6LOlBfP/view?usp=sharing

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I. Prologue

At last, it's over. From next, I will be able to write about TQM.

But for now, one clarification about the New QC 7 Tools: These are indeed meaningless, but they are part of TQM. Therefore, I wrote these.

All meaningless? These can be replaced with other, better tools.

There was just one helpful tool. It was the Part Chart. I introduced the case of a company. And this company made a huge Part Chart by KJ.

Why does this case have a meaning? The answer is (as you already feel) the necessity of Creative Thinking.

Part Chart.

This diagram requires writing out every detail of the process, which necessitates the use of Creative Thinking capacity.

Other New QC 7 Tools? …I haven't seen using these as a tool of Creative Thinking. However, most of the cases I saw were just materials for the presentation.

Taguchi Methods.

It is one of the academics. And it is an instrumental Design of Experiments. And it is not possible to replace with AI. Recently, some support tools have been developed to implement it. These are Minitab, Design-Expert, Qualitek, and JMP.

Indeed, it is becoming a convenient world now. And please never forget that quality must be built in the designing phase.

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II. Taguchi Methods

Long days ago, when I was a design engineering manager, I received some training. It was the training of Taguchi Methods. I think the Taguchi Methods are a good procedure. However, at that time, the use was so difficult for me.

Before proceeding to the main explanation, I outline the key framework of this method. And please understand the procedure of this method.

1. Procedure 1: **Plan an experiment**
    1. Identify the core functions (Clarify the functions)
    2. Deciding the measuring characteristics
    3. Input/Output configuration
    4. Setting control factors
    5. Setting noise factors
    6. Assignment to an orthogonal array
2. Procedure 2: **Orthogonal array experiment**
3. Procedure 3: **Data processing**
    1. Analysis using SN ratio (calculate SN ratioη, β1, β2).
       SN ratio; Signal-to-Noise Ratio
    2. Creating a Cause-and-Effect Diagram
4. Procedure 4: **Post-experiment considerations**
    1. Setting optimum conditions
    2. Gain Estimation
    3. Confirmatory experiment

Umh…oh!, we are in trouble…

Once again, this technique proves to be very useful. But, but. To be honest, it was extremely difficult for me.

I will write later, from now on (2025, Jul); however, AI will completely replace this method. Therefore, if you don't want to read, please ignore this theme. However, it is essential to understand that quality should be built into the design (quality by design).

S/N ratio MINITAB support website

And this method is better than others, such as FMEA (Failure Mode and Effects Analysis) in my personal view. However, after Procedure 3, it is so difficult. And I gave up continuing after Procedure 3.

Because there is a following calculation. Just as a matter of example, the SN ratio[3] calculation formula:

[3] S/N ratio MINITAB: https://support.minitab.com/en-us/minitab/help-and-how-to/statistical-modeling/doe/supporting-topics/taguchi-designs/what-is-the-signal-to-noise-ratio/
Gemini: "*In the Taguchi method, the Signal-to-Noise (S/N) ratio is a statistical measure that quantifies the robustness of a process or product by considering both its average performance (signal) and its variability (noise). It helps to maximize the output while minimizing undesirable variation by analyzing different S/N ratio types, such as "smaller is better" or "nominal is better," to achieve a high.*".

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$$SN = -10 \cdot \log_{10} \left(\frac{1}{n} \sum_{i=1}^{n} \frac{1}{y_i^2} \right)$$

I was in over my head. At that time, there was no convenient tool like Minitab or Excel. Now you can use these; such is my excuse, and it shouldn't be accepted.

First of all, there are very special words from many: Robust design (It may be understandable.) Parameter designing, DOE (Design of Experiments), Orthogonal Array, SN ratio (Signal-to-Noise Ratio), etc. However, please disregard this, as computer calculation software such as Minitab is now available.

Following is my experience (receiving the training) record.

My experience & training

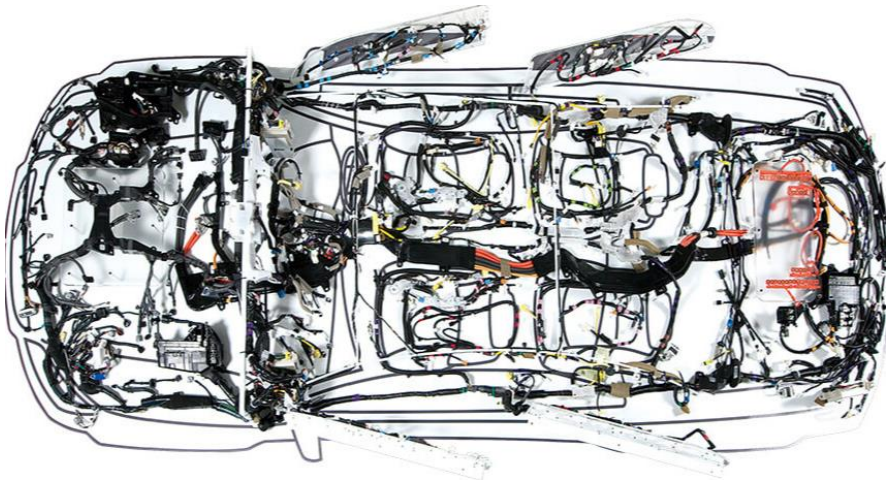
When I got this training, it was a timing of a vehicle's model change (and change of wiring harness). Then I chose the theme of "quality by design (quality built in design)" in this new wiring harness.

Based on my experience, I introduce this Taguchi Methods.

Outline of Wiring Harness.

If you don't like this note, please ignore it.

I believe, you know wiring harness of vehicles. Because sometimes, I wrote in my series. However once again, I write it for your good understanding about example use of Taguchi Methods.



Were [1/y²] = Mean-square deviation – MSQ.

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The above picture is a skeleton of a passenger car. And, You can see something dark and messy-looking, right? These are wiring harnesses.

In addition to the picture above, it is the largest wiring harness (body harness) in a car. As you can see in the image above, a vehicle has multiple wiring harnesses.

A passenger car has such an electric circuit of 3000~5000. The total cable length exceeds 3 km.

The following are the kinds of passenger car wiring harnesses. And, my previous company, SWS (Sumitomo Wiring Systems), is the top share of the world.

1. ***Main harness (the main line).***
   Body harness, Engine room main harness, Floor harness (harness connecting front and rear).
2. ***Function-specific harnesses***
   Engine harness (engine control system), Chassis harness (running system). Instrument harness (instrument panel/dashboard), Door harness (for each door).
   Rear harness (rear system).
3. ***Special Function Harnesses.***
   Battery Harness, HVAC Harness (Air Conditioning System).
   Seat Harness (Power Seats, Seat Heaters), Safety Harness (Airbags, Safety Devices).
   Roof Harness (Ceiling Wiring), Lexus-Specific Harnesses.
4. ***Luxury Car Specific.***
   Sensor Harness (Camera/Radar Sensor), ADAS Harness (Autonomous Driving Support System), Premium Audio Harness, Ambient Lighting Harness.
   Mark Levinson Audio System Harness.
5. ***Electrification-Ready.***
   EV/Hybrid Vehicle Harness, High-Voltage Harness (Battery/Motor System) .

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Charging Harness (Power Supply System), Inverter Harness.

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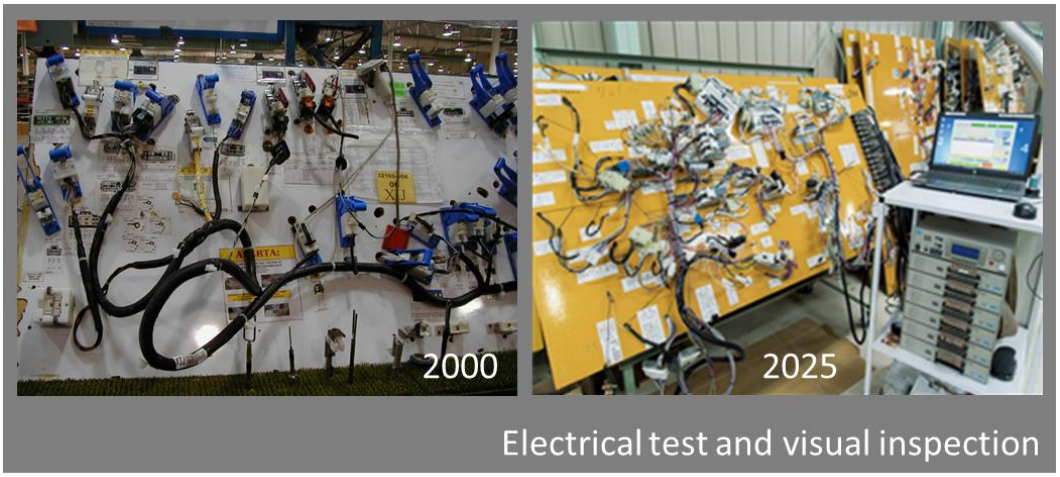

These photos show the wiring harness production process. The pictures on the left-hand side are the Mexican plant in 2000 and 25 years ago, in addition to the right-hand side photos, which are from the current process (as of July 2025).

Yes, as you understand, there is no change. It is the meaning of no improvement in the fundamental part.

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Of course, there are new wiring harnesses according to the appearance of new vehicles, such as EV, HV, PHV, and autonomous driving by AI. But there is no change in the structure (of course, even new components have been added).

Regarding the market. It's also a stable market, even in situations where vehicle fundamentals have changed.

Indeed, the wiring harness business… It is a very interesting business, it is!

Now, after gaining an understanding of wiring harness construction, I would like to introduce the central theme: **Taguchi Methods**.

Once again, when I was the design manager, I got the training course. And the following is the record of this training course.

It's not essential, but the attendees were about 50 people. The groups (each consisting of 5 persons) were tasked with a discussion. Our group participated. However, the other group of members were a little shy, and the conversation didn't flow.

Then, I suggested using the Taguchi Method, as illustrated by my example of a wiring harness.

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Solution to the fundamental quality issue of wiring harnesses using the Taguchi Method.

I explained the vehicle's wiring harness construction to them, using samples and photos. Then we started the discussion.

Specific steps for applying the Taguchi method:

1. **STEP 1: Define functions and clarify quality characteristics**
   1.1. Set basic functions:
   Clearly define the basic functions of the wire harness.

   A. Stable transmission of current
   B. Maintain mechanical connection
   (There was no objection from them.)

   And, we chose the crimping process as the theme rather than the entire wiring harness process.

   Crimping process

   1.2. Selection of quality characteristics
   A. Set measurable quality characteristics:
   1.2.A.1. Contact resistance (electrical characteristics)
   1.2.A.2. Tensile strength (mechanical characteristics)
   1.2.A.3. Withdrawal force (connection strength)

2. **STEP 2: Select control factors**
   2.1. Select factors that can be controlled during design and manufacturing:
   Control **factors** in the crimping process
   A. Crimping pressure (level: low, medium, high)
   B. Crimping time (level: short, medium, long)
   C. Terminal shape (level: Type 1, Type 2, Type 3)
   D. Wire material (level: copper, copper alloy, aluminum)
   E. Coating material (level: PVC, cross-linked PE, heat-resistant material)
   F. Crimping tool type (level: A tool, B tool, C tool)
   G. Working environment temperature (level: low, medium, high)

3. **STEP 3: Setting error factors (noise)**
   3.1. Set the variable factors that occur during product use:
   External disturbances (operating environment)
   A. N1: Operating temperature (-40°C to +80°C)
   B. N2: Humidity (20% to 90%)
   C. N3: Vibration (present/absent)
   Internal disturbances (ageing)
   D. N4: Operating time (initial to 1000 hours)

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E. N5: Corrosion progression (initial to advanced)

Product variation

F. N6: Wire diameter tolerance (±5%)

G. N7: Terminal dimension tolerance (±3%)

4. **STEP 4: Selecting an orthogonal array and designing an experiment**

4.1. Selecting an orthogonal array

In the case of seven control factors (three levels) and seven error factors:

A. Inner orthogonal table: L27 (3^13) used

B. Outer orthogonal table: L8 (2^7) used

C. Now Orthogonal array L27? What is the L27 orthogonal array in the first place?

In short: It is a design table (experimental design table) for efficiently combining three levels of factors in an experiment.

Levels and Factors?

For instance, the Crimping process in a Wiring harness:

Levels and Factors in Crimping process in Wiring harness				
Factor symbol	Factor Name	Level 1	Level 2	Level 3
A	Presure force	Low	Medium	High
B	Core wire lengt	Short	Medium	Long
C	Crimping space	Round	Oval	Square
D	Pressing speed	Slow	Medium	Fast
E	Wriire diameter	Thin wire	Standard	Thick wire
F	Operator experience	< 1 year	1-3 years	Veteran

As you see **A** to **F** total 6 are **factor** symbols. Factor name. These are the factors related to quality issues of crimping. (In here, these are not related to current standard.)

Level: **Low (1)**, **Medium (2)** and **High (3)**, etc. Once again, it is a design table (experimental design table) for efficiently combining three levels of factors in an experiment. Why is it necessary?

Normally, when there are many factors (parameters), a 'full experiment' that tries all combinations becomes enormous.

This case crimping: 6 factors (A..F) × 3 levels (1..3) each ➔ 3^6 = 729 combinations.

In a reality, it is impossible to do the experiments. Therefore, Taguchi's method uses a combination table called an 'orthogonal array' that can separate the main effects of factors with a minimum number of experiments.

Let's make up the experimental design table: This case 3 levels and 6 factors. L27 orthogonal array can be used. Following is the L27 orthogonal array:

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L27 structure of L27 orthogonal array (excerpt)						
Experiment No.	A	B	D	C	E	F
1	1	1	1	1	1	1
2	1	1	2	2	2	2
3	1	1	3	3	3	3
4	1	2	1	2	3	3
5	1	2	2	3	1	1
6	1	2	3	1	2	2
7	1	3	1	3	2	2
8	1	3	2	1	3	3
9	1	3	3	2	1	1
…						
27	3	3	2	1	3	2

What are these numbers and characters array? …Not understandable?

Never mind. Firstly, you can get these structures (L27, L9, etc.) in SNS (such as Excel). Therefore, please don't mind for now. And, secondly, these figures (1, 2 and 3). The necessity of these figures is for the calculation of SN ratio. These were also settled by the Taguchi Method.

$$SN = -10 \cdot \log_{10}\left(\frac{1}{n}\sum_{i=1}^{n}\frac{1}{y_i^2}\right)$$

The roots of these numbers and structures? …I don't know and cannot explain.

Now, based on this information, I attempt to develop this method using the case of the Crimping process.

The following is the report submitted to this training course:

1) Background:
   Terminal crimping using a crimping machine can sometimes result in defects, such as poor conductivity and insufficient tensile strength. In this analysis, the Taguchi method is applied with the aim of optimizing the crimping conditions, reducing the variation in “tensile strength (breaking load)”, and improving reliability.
2) Objectives:
   - Reduce variation in tensile strength (N) and improve the average value.
   - Find optimal conditions to stabilize reproducibility and quality.
3) Factors and Levels:

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Factors and Levels				
Factor	Contents	Level 1	Level 2	Level 3
A	Cramping presure	15 kN	20kN	25kN
B	Crimping time	0.5s	1.0s	1.5s
C	Conductor insertion length	2.5mm	3.0mm	3.5mm

4) Experimental design table (L9 orthogonal array)

L9 orthogonal array			
Experiment No.	A (Pressure)	B (Time)	C (Insertion length)
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

5) Measured data (Tensile Strength in Newtons)

Measured data	
Experiment No.	Tensile Strength N
1	41
2	45.2
3	48.5
4	44.3
5	50.1
6	42.7
7	47.8
8	43.1
9	49.4

6) Calculation of the Signal-to-Noise ratio (maximum characteristic)

$$SN = -10 \cdot \log_{10}\left(\frac{1}{n}\sum_{i=1}^{n}\frac{1}{y_i^2}\right)$$

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Here, for simplicity, we assume that each experiment is measured once (n = 1). Therefore:

- SN ratio for Experiment 1 (41.0 N) = −10log10(141.02) = −10log10 (0.000594) ≈ 32.26.-
- SN ratio for Experiment 2 (45.2 N) = −10log10(0.000490) ≈ 33.10.-
- SN ratio for Experiment 3 (48.5 N) = −10log10(0.000425) ≈ 33.71-
- SN ratio for Experiment 4 (44.3 N) ≈ 32.93.-
- SN ratio for Experiment 5 (50.1 N) ≈ 34.00.-
- SN ratio for Experiment 6 (42.7 N) ≈ 32.61.-
- SN ratio of experiment 7 (47.8 N) ≈ 33.60.-
- SN ratio of experiment 8 (43.1 N) ≈ 32.68.-
- SN ratio of experiment 9 (49.4 N) ≈ 33.87.-

7) Analysis of optimal conditions based on SN ratio (factor effect diagram: omitted)

- Crimp pressure: Maximum average signal-to-noise (SN) ratio at level 3 (25 kN)
- Crimp time: Maximum at level 2 (1.0 s)
- Conductor insertion length: Maximum at level 3 (3.5 mm)

8) Conclusion and future initiatives

- It is suggested that the optimal conditions are a crimping pressure of 25 kN, a time of 1.0 s, and a conductor insertion length of 3.5 mm.
- In the future, we will conduct "retesting (confirmation experiments)" to confirm reproducibility and verify variability trends and long-term reliability.

(Puff… I'm done at last.)

If I say the conclusion, the trustworthiness of the current inspection standard is proven.

Crimp Height, Crimping Position and Destructive Testing (Terminal Retention Force)

When writing this column, a News was highlighted. Then, Ahh, I had a feeling... but I will come back later to this history.

The New QC 7 tools and Taguchi Methods are: Affinity Diagram, Relations Diagram, Tree Diagram, Matrix Diagram, Arrow Diagram, Process Decision Program Chart and Matrix Data Analysis. Additionally, I wrote this Taguchi Methods.

It has finally been done…

Everyone, please understand that now we live in the world of AI. And it is expanding more and more. Diagrams by New QC 7 tools? AI can now create all of these, so there's no need to remember the New QC 7 Tools. They're practically meaningless. Once again, it is the world of AI (Artificial Intelligence), and it is expanding.

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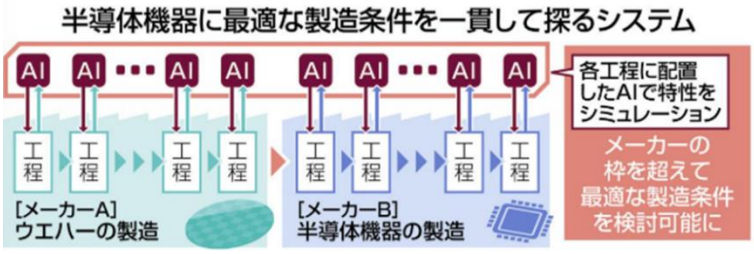
And your task is now: how can you use AI? However, even with the use of AI, you are still required to have **creative thinking**. Therefore, I encourage you to hone your capacity for **creative thinking**. How? With KJ.

Regarding the Taguchi Methods. The Taguchi Method is a good thought and useful. And I thought you should learn and use it.

By the way…

> *Before yesterday (2025 07.20), I read a column in a Newspaper. Next is the column.*
>
> *Optimising manufacturing conditions for silicon wafers, a semiconductor material, with using AI. Nagoya University and others aim to shorten development time 16 July 2025.*
>
> *A research group led by Professor Toru Ujihara (Materials Engineering) at Nagoya University has developed a system that can simultaneously determine the optimal manufacturing conditions for each product using silicon wafers, a material used as a semiconductor substrate in electronic devices. Previously, handling confidential corporate information posed a barrier, resulting in significant time consumption at each stage of the process. However, by leveraging artificial intelligence (AI), the required time has been reduced to approximately one-thousandth of the previous duration. This development is expected to enable efficient product development beyond the boundaries of individual manufacturers.*



> *Silicon wafers are disc-shaped materials used as semiconductor substrates in many electronic devices, such as home appliances and automobiles. Each product requires an optimal wafer, which is manufactured by wafer manufacturers upon order. Product manufacturers then use these wafers to make semiconductor devices. However, due to the confidential nature of each company's information, it has been difficult to consistently improve manufacturing conditions.*
>
> *In the newly developed system, the manufacturing process for image sensors used in smartphones and other devices is replicated on a computer. AI is deployed across approximately 30 processes handled by both wafer and device manufacturers. The system instantly predicts the effects of changing conditions such as temperature and time during heat treatment, enabling the identification of optimal manufacturing conditions.*
>
> *As a result, condition exploration that previously took one year to complete using conventional experiments can now be completed in eight hours using the new system, and the calculation time per run has been reduced from one hour to three seconds. This enables rapid development of high-performance products in the highly competitive semiconductor industry. The team also explored mechanisms for*

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cooperation that protect corporate secrets without directly exchanging manufacturing data between companies.

Professor Ujihara emphasises, 'If we can create a similar system for all processes related to semiconductors, we can achieve competitiveness on par with leading manufacturers worldwide.'

When I read this News, I thought that we can use AI for Taguchi Methods. But I understood that Taguchi Methods cannot be replaced to AI. I finally write this reason and finish this column.

Taguchi Methods and AI.

As reported above, a research group led by Professor Toru Ujihara (Department of Materials Engineering) at Nagoya University has developed a system that utilizes AI to investigate the optimal manufacturing conditions for each product simultaneously. Will AI replace the Taguchi Method in the future?

0) Firstly, facing the conclusion:

The AI-based manufacturing condition optimization system "MetaFactory" developed by Professor Toru Ujihara of Nagoya University and his team is an innovative technology that enables the rapid optimization of the entire manufacturing process, which was previously difficult to achieve using conventional methodologies. Rather than completely replacing Taguchi Method (quality engineering), the evolution of AI technology is expected to lead to the progressive inheritance of its basic concepts and ideas, which will then be integrated with AI.

In particular, AI-based methods are likely to become mainstream in scenarios involving complex processes with numerous variables or where rapid optimization is required. On the other hand, the fundamental principle of ensuring robustness against noise inherent in the Taguchi Method is expected to be incorporated into AI optimization as well.

In the future of manufacturing, the combination and integration of both methodologies, leveraging their respective strengths, will enable the realization of more advanced process optimization.

1) Research content (summary) by Professor Ujihara and his team at Nagoya University

Professor Toru Ujihara (Nagoya University, Materials Engineering) and his research team have reportedly developed a system that uses AI to extract the optimal manufacturing conditions for each product in a single process. This method applies AI to

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- Multiple factor combinations
- Non-linear relationships

pattern extraction from large amounts of data to efficiently find optimal conditions,

- Rather than trying each factor one by one as in the past.

2) Differences and similarities between the Taguchi Method and AI

Perspective	Taguchi Methods	AI/Machine Learning
Main Features	Search for optimal conditions from a small number of experiments	Learn patterns using vast amounts of data
Approach	Statistical planning methods (orthogonal arrays, signal-to-noise ratio)	Statistics + exploration algorithms (neural networks, etc.)
Target	Experimental design. Quality engineering	Data-driven optimization
Interpretation of results	Easy for humans to understand	Tendency toward black-boxing
Number of experiments	Few (efficiency-oriented)	Many (depending on computing power)

Qualitek-4[4]

Qualitek-4 (QT4) is dedicated Windows software that supports Taguchi Method experimental design and statistical analysis.

Developed in the 1990s by Dr. Ranjit Roy of Nutek, Inc., it enables efficient experimental design and analysis utilising orthogonal arrays, which were devised by Dr. Genichi Taguchi in the 1950s.

It efficiently supports the entire process from experimental design to statistical analysis of results and prediction of optimal conditions. A key feature is its ability to perform advanced statistical analyses such as complex orthogonal array design, interaction analysis, and signal-to-noise ratio analysis without requiring specialised

[4] Qualitek-4: https://qt4.link/ *Notice: Qualitek-4 is no longer available for sale and there is no support available for this downloaded FREEWARE version or previously purchased user-licensed from Nutek Inc. – QT4 Developer, 240202*

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statistical knowledge. It serves as a practical tool for engineers and quality control professionals engaged in product design/development and manufacturing process optimisation.

Taguchi Methods.

Difficult? Please never mind, it is a very convenient world now. Because there are many support tools developed that can be used. In these support tools, I introduce Qualitek-4.

Qulitek-4

Main Functions and Features

Experimental Design Function

1) *Automatic Design:*
   Simply enter the factors (variables) and levels to select the appropriate orthogonal array automatically.
   Can handle up to 63 factors.
   Supports 2-level, 3-level, and 4-level factors.
2) *Manual Design:*
   Select from a list of standard orthogonal arrays.
   Supports various orthogonal arrays such as L-4, L-8, L-9, L-12, L-16, L-18, L-27, L-32, L-36, L-54, L-64, and L-81
   Can also create user-defined orthogonal arrays
3) *Special experimental design:*
   Outer orthogonal table design using noise factors
   Interaction analysis possible
   Dynamic characteristic experiment design (supports up to 12 types of signals and 10 types of noise levels)

Analysis functions

1) *Basic analysis:*
   Standard analysis (using mean and standard deviation)
   Signal-to-noise ratio (SNR) analysis (six different calculation formulas)
   Supports quality characteristics where 'higher is better,' 'lower is better,' and 'nominal value is best'
2) *Main effects and ANOVA:*
   Main effect graph display and printing
   Automatic calculation of analysis of variance (ANOVA)
   Significance test for factors (individual or all factors analysed at once)
3) *Interaction analysis:*
   Detection and graphical representation of interactions between two factors
   Analysis of interactions between factors with two, three, or four levels
   Comparison of the significance of interactions
4) *Prediction of optimal conditions:*
   Prediction of performance under optimal conditions
   Calculation of confidence intervals (C.I.)

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Function to convert from SN ratio to original measurement units

Graphical display

1) *Main effect graph: Visually displays single or multiple main effects*
2) *Interaction graph: Visually displays interactions between factors*
3) *Pareto chart: Displays the degree of influence of factors using bar graphs and pie charts.*
4) *Stacked graph: Displays the contribution of each factor to the optimal conditions.*
5) *Quadratic curve approximation using the least squares method: Approximation curve between the average effects of 3-level and 4-level factors*

Practicality and Application Fields

Qualitek-4 is widely used for optimising product and process design and solving production problems. It is particularly useful in the following industries:

Automotive industry, Electronics industry, Plastics industry, Food industry, Pharmaceutical industry, Aerospace industry, Defense industry

Current situation

Qualitek-4 is currently distributed as free software. It was formerly sold by Nutek Inc., but is now provided as unsupported freeware and can be downloaded from the official website: https://qt4.link/

Phew! Finally done! Writing about the QC 7 tools was indeed not interesting to me. Sorry!

From the next column, I would write about the TQM story.

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III. Jishu-Ken VI group exercise: TPS[5]

Hablemos de "Costo". Pero de esta columna, necesito cambiar el tema de Costo a TPS (Sistema de Producción Toyota). Este grupo **Jishu-Ken** eligió TPS como tema de su ***Jishu*** (自主; Autoevaluación) - ***Ken*** (研; Estudio).

TQM-12 JISHU-KEN IV Cost Control working group

Los miembros de este grupo ***Jishu-Ken*** son Em (Ingeniería), Hr (Recurso Humanos), Sm (Ventas), Mp (Planificación de la Producción) y Pm (Producción). Af (Contabilidad) como nuevo miembro.

¿Por qué TPS? Permítanme explicar primero el contexto de su elección.

De hecho, esta empresa estaba al borde de la bancarrota. No, esta expresión no era correcta. Cuando recibieron la formación de **Af** sobre Balance General, comprendieron la situación actual de su empresa a través de las cifras.

De hecho, el Director General me había solicitado asesoramiento. De hecho, el propósito de que la Sede Central enviara a nuestro Director General era resolver los aspectos financieros. Y la sede central declaró el cese de la oferta monetaria. Era el significado de insolvencia. No, era incorrecto. Esta empresa había estado en situación de insolvencia.

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Declaración de quiebra.

Y se declaró que se haría en dos etapas. Una oportunidad era la de autodesarrollo liderando al Director General y desplegando el grupo

[5] **Cost reduction/control** is a series of lectures about the interpretation of different costs regarding calculating the Profit and Loss statement adequately, depending on the activity and policy of the company:

JISHU-KEN V – Cost Reduction – 12: [eng] https://archive.org/details/tqm-12-matrix-data-analysis
JISHU-KEN IV – Cost Reduction – 11: [eng] https://archive.org/details/tqm-11-process-decision-program-chart/page/n49/mode/2up
JISHU-KEN III – Cost Reduction – 10: [eng] https://archive.org/details/tqm-10-the-matrix-diagram-and-qcc-working
JISHU-KEN II – Cost Reduction – 9: [eng] https://archive.org/details/tqm-9-pfmea/page/n35/mode/2up
JISHU-KEN I – Cost Reduction – 8: [eng] https://archive.org/details/tqm-8-the-arrow-diagram/page/n37/mode/2up Example of ***Jishu-Ken*** sessions of a middle managers working group: The group was studying the break-even point of the operations to reach profits in the short and medium term.
Cost Reduction – 7: [eng] https://archive.org/details/tqm-5-the-kj-method/page/n47/mode/2up
Cost Reduction – 6: [eng] https://archive.org/details/tqm-3-hardware-software-diagnose-cost-reduction-6
Cost Reduction – 5: [eng] https://archive.org/details/tqm-2-introduction-2-cost-reduction-5
Cost Reduction – 4: [eng] https://archive.org/details/tpm-16-oil-control-5/page/8/mode/2up
Cost Reduction – 3: [eng] https://archive.org/details/tpm-15-cost-reduction-3-and-consultancy-job-contnuation
Cost Reduction – 2: [eng] https://archive.org/details/tpm-14-clasification-of-cost-and-oiling
Cost Reduction – 1: [eng] https://archive.org/details/tpm-13-oil-control-3/mode/2up

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DOPE (Desarrollo de la Eficiencia de la Planta); sin embargo, este nombre es ficticio. Y si estas etapas no tenían éxito, se tomaría la decisión final.

Let's talk about “Cost”. But from this column, I need to change the theme from Cost to TPS (Toyota Production System). This ***Jishu-Ken*** group chose TPS as the theme of their ***Jishu*** (自主;**Self**) - ***Ken*** (研;**Study**).

The group members of this Jishu-Ken are **Em**; Engineering, **Hr**; Human resources, **Sm**; Sales, **Mp**; Production planning and **Pm**; Production. **Af**; Accounting staff (new member).

Why TPS? Let me explain the background of their choice first.

It was indeed this company that was on the edge of a bankruptcy cliff. No, this expression wasn't correct. When they received the BS (Balance Sheet) teaching from **Af**, they understood their company's standing position through numbers.

Actually, I had been approached for advice by the Managing Director. In fact, the purpose of our Managing Director being dispatched by the Headquarters was to resolve the financial aspects. And he was declared the stop of the money supply no more by HQ. It was the meaning of insolvency. No, it was incorrect. This company had been in the situation of insolvency.

Declaration of bankruptcy.

And it was declared that it would be done in 2 steps. One opportunity was the chance for self-development by leading the Managing Director and dispatching the DOPE (Development of Plant Efficiency) group; however, this name is a fiction. And if these steps weren’t successful, the final decision would be declared.

Unusually, they all came to my office together. They were serious expressions.

—Sensei —the **Em** then asked me—. We believe you already know our company's distress. Last time, when I came here, you gave me the suggestion about the countermeasures for our business change.

—Business change —he mentioned—. It is the change of mass production style to High-Mixed low-volume production.

—Is that suggestion the meaning of the TPS introduction? Is that so?

—No, it is not —I denied—. That example is just one technique or concept of TPS. Basically, it is not necessary to introduce TPS itself, and it is also not feasible for your company at this time. It is necessary to determine the direction of the production system by carefully examining your products and conducting a market survey. However, it is crucial to have inventory, even though you will make any receiving order and production style. For it, you need to choose a better system carefully.

The **Mp** tried to understand: —Our business model is now clear and was confirmed by top management. Sensei —he asked honestly—, as you already know, our plant's production and

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receiving orders are High-Mixed Low Volume. But our plant hasn't been able to adapt to it. Also, "Inventory is evil". It is your word, isn't it?

—Yes, it is —I agreed—, no having inventory. Saying easy, but to realize it, it is necessary to achieve many other things first, from the nature of receiving orders to delivery. Also, it is essential to consider design engineering…

—Why do you need to have inventory? —I asked them figuratively, and I asked myself— Quick response to the customer? …Manufacturing performance? …When seeing the real LT (Lead Time) for receiving an order to delivery, how many days are necessary? …No, it is no "days" when saying LT. Actual lead time is less than 1 hour from body punching press to assembling parts into the body, inspection and delivery area. It is pretty clear when looking just at LT, it is not necessary to have inventory. But it is also clear that it is necessary to have a minimum inventory, including WIP (work-in-progress). To realize it, what system and how do you introduce it…

—You emphasized often High-Mixed Low Volume production. What is your definition of High-Mixed Low Volume? For instance, the product series of H, W and L. These are now your main products. Are these High-Mixed Low Volume products? If fact, these are constituted of derivative models due to the customers' requirements. However, these are just derivative models. In my opinion, these are not High-Mixed Low Volume products, but Very Low-Mixed High-Volume products. These are other facts. You are receiving orders of spot products. Also, you are receiving an order for a brand-new product development…

—These are indeed High-Mixed Low Volume. Everyone. What do you want? It is true that "Inventory is evil". I think it is a good direction to seek "No inventory production". If you desire it, you need to change the receiving order style to "made-to-order production system". Toyota is taking this system by TPS. On the assembly line, all products are allocated to an order. But he needs to have a minimum inventory controlled by Kanban. And his line is basically adapted to Mixed (products) production.

The **Sm** hesitated: —Hmmm... I understood we need to survey our products, not only those that are new but also those that are future prospects.

—Also, the Em considered as well, we need to think about not only the product issues, but also our engineering matters, such as design engineering and production engineering.

Then I call their all attention: —Everyone. Thanks for visiting me. Let me I give you a task. Of course, if you like, please come to see me. Any time it is welcome. If you come next, please confirm and let me know "5 years' corporate strategy" and next year's annual policy. OK?

…

5 years' corporate strategy. Annual policy and Annual action plan.

The following was the idea and conversation deployed in their ***Jishu-Ken***

***6th Jishu-Ken* for TPS introducion**
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The **Em** led the self-study group meeting: —Last time Sensei gave us 2 tasks. One is the issue of Strategy and Annual policy. Another is to check the factory capacity using the Factory Management Check List.

—First, long-term strategy and Annual policy —the Em proposed and he asked to Pm—. Mr. Pm. How was your study?

—OK, everyone —the **Pm** started his exposition—. I studied these in a textbook and got the following teachings about the Corporate Long-term Strategy and the combination with Annual policy…

—In any case, the formulation of long-term strategies and annual policies is an essential element for companies to achieve sustainable growth. By maintaining a long-term perspective while ensuring short-term execution capabilities, companies can strengthen their competitiveness in a rapidly changing business environment and continue to meet the expectations of their stakeholders (in our case, the head office). It is important to position this strategy formulation process not merely as a planning exercise, but as a critical management activity aimed at unifying the organization's awareness and enhancing its capabilities. Developing long-term strategies and annual policies within a company is essential for clarifying the organization's vision, optimizing resource allocation, and managing risks…

—Additionally, annual policies serve as concrete measures to set short-term goals and promote performance improvement. These strategic initiatives contribute to the company's sustainable growth and stability.

—Yes, it is correct. I believe so —the **Em** agreed.

—I also knew so —the **Hr** confirmed—. But once again, we need to confirm it in detail.

The **Sm** asked then Pm: —Mr. **Pm**, could you explain it them more exactly? ..How can we treat?

—Let's cascade down these more details —the **Pm** continued with his exposition—…. The necessity of formulating a long-term strategy and its relationship to annual policies.

—First, **long-term strategy** (looking five years ahead)

1) **Clarification of direction**

   A long-term strategy clearly defines the future vision and goals of the company and serves as a 'North Star' that allows all employees to work toward the same goal. This creates a sense of unity throughout the organization and enables efficient management.

   Of course, it is important to constantly review the strategy.

2) **Building competitive advantage**

   By anticipating changes in the market environment and preparing ahead of competitors, we can establish sustainable competitive advantage. Through long-term investment decisions, we can achieve significant results that cannot be obtained through short-term profit pursuit.

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Our company is currently in a very dangerous situation. DOPE has been dispatched, and policies focusing on cost cutting (not cost kaizen) are being promoted, but we need to take a step back and determine what we should do. Unfortunately, we have reached this point without knowing whether the company has a long-term strategy or not. Next.

3) Risk Management and Opportunity Creation

By identifying future risks in advance and implementing countermeasures, we can enhance the stability of the company. At the same time, we can explore new market opportunities and technological innovations, nurturing the seeds of growth. I wish we had seized this opportunity sooner. But I don't think it's too late yet.

—Following now, the annual policy —the **Pm** continued…

The Significance of Establishing an Annual Policy

1) Concrete Implementation of Long-Term Strategy

We translate long-term strategies into realistic annual goals and convert them into actionable plans. This ensures that strategies are not merely theoretical but lead to concrete execution.

I casually mentioned the introduction of TPS, and the professor admonished me to 'think carefully.' Should we include the introduction of TPS in the annual policy? I suppose we should first conduct a thorough analysis of the current situation before making any recommendations.

2) Optimization of Resource Allocation

This serves as a guideline for allocating limited management resources (human resources, funds, time) in the most effective manner. It allows us to clarify priorities and avoid unnecessary investments. Still, DOPE is too violent.

3) Progress Management and Course Correction

Through regular progress checks, we can measure the degree of goal achievement and adjust the strategy as necessary. This enables the organization to respond flexibly to environmental changes.

—In any case, I think the key is the annual action plan. This time, we must not let it end up as a mere wish list. And **the interaction between the two** —the **Pm** continued...

1) Ensuring consistency

By linking long-term strategies and annual policies, it is possible to achieve a balance between short-term results and long-term value creation.

2) Building trust with stakeholders

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Companies with clear strategies and policies are more likely to gain the trust of investors, customers, and employees, thereby establishing a stable management foundation.

In our case, the stakeholders are the headquarters. The long-term strategy, annual policy, and annual action plan must be ones that the headquarters can approve of.

3) Promoting organizational learning

Additionally, the strategy formulation process itself serves as an opportunity for organizational learning, leading to improved market understanding and management capabilities. I personally found it very educational. What about everyone else?

—Good job Mr. **Pm** —**Hr** appreciated his exposition— And? …and what was the Sensei's comment? It is not just your comment, is it?

—Yes, everyone —the **PM** called their attention—. This is purely my study. Please believe it. And the Mr. **Hr**'s question is just offensive. But it is true visiting his office and having a conversation regarding corporate strategy and annual policy.

—And he said the word of "JFC".

—JFC? —the **Sm** asked—What is this? Sometimes ***Sensei*** says something mysterious. JFC? Is it a mistake of JFK, isn't it? …JFK is the meaning of Jone F. Kenedy former US president, and he was assassinated.

—Ha, ha, ha —the **Pm** laughed—. It is not JFK, but JFC. He said our company is JFC. Its meaning is Jellyfish Company. As you know, a jellyfish has no backbone. And our company has no backbone like jellyfish. He said, the series of stories of Strategy, Annual policy and Annual action plan is the corporate backbone. For long years, our company has had and still has no backbone. And I told him that our position is like one plant of HQ. Therefore, such a series of stories should be the task of HQ.

—Mmmh… I also thought so —the **Mp** agreed then—. And our task is to follow the HQ's policy. And? What should we do?

The **Pm**, and just nodding just a little, mentioned: —I asked the same question to **Sensei**. But he told me nothing while laughing, but, as he usually said, "think about it by yourself". So, what should we do?

—OK—the **Em** agreed—, but... Wait a minute, everyone... We are doing **Jishu-Ken**, which means Self learning. And, it is not our aim to find solutions.

Then, the **Sm** just clarified: —We already know this, but we were suggesting top management as members of the management team. Therefore, I personally wish to find a solution, including the treatment for DOPE.

—My department —he continued—, the Sales department, made the marketing survey. And the results were as follows:

1) Products H, W, and L.

   These are Medium-Mixed Medium Volume products.

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The market for these will continue. But New designs should be considered.

Now, these are mainly derivative models for customer customization. And my suggestion is to integrate this function of customization. And to create new products.

There is the market.

2) High-Mixed Low Volume products.

We have some other kinds in this category. And some of this category may have a particular market. Then, my department is planning a special customer visit to dig into the market needs. It is the meaning of digging the new series, such as H, W, and L.

—But… I have a concern about an engineer issue —the **Sm** mentioned.

—What? —the **Em** some kind disagreed—. Engineering issue? My department also needs to take countermeasures for DOPE, which requires me to reduce the number of staff. But Mr. **Sm**, your activity and information are a great help to my department. Concern about an engineering issue? Please don't worry about that.

—No, not the engineering capacity issues —the **Sm** tried to clarify—. I believe you and your department. And my more profound concern is the ***Production Gemba*** capacity issue. It is necessary to adopt High-Mixed Low volume production with no inventory. I cannot believe our plant can apply to it.

—Therefore —the **Mp** hesitated and repeated—, therefore, the solution is TPS, isn't it? I believe ***Sensei*** gives us the advice.

—No, I don't think so —the **Hr** disagreed—. And I also believe it must be essential to have his guidance. However, there is one of hurdle. And it may involve having the corporate backbone (Corporate Strategy, Annual policy, and Annual action plan).

The **Mp** clarified my thinking: —Sensei told me that JFC doesn't have the capacity to make it up and only we can make the so-called "wish list".

—Wish list —the **Em** repeated—. It is the annual action plan of the Production department led by our Production Manager. It has the item of JIT introduction in its action plan. But the implementation is nothing so far. Probably, not only our Production Manager, but also we misunderstood the Annual Action plan. It must never be merely a wish list; action items should be completed within the period…

—His words: A company with no corporate backbone can never introduce such a deep system. One of his messages is that it should be a company-wide activity. And then, the story of "Corporate Strategy, Annual Policy and Annual Action Plan" is essential. Another one of his messages is that the president of this project is the company's top, and in our case, it is our Managing Director…

And **Em** continued talking over an example heard from the Kimura Sensei: —The Sensei also told the story of SUMITOMO's case (SWS;

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Mp: Material Section Procurement Manager.
Hr: Human Resources Staff.
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Sumitomo Wiring Systems). His previous company also tried to introduce TPS (customized TPS). And it succeeded. In his case, this monthly review was also led by the former president.

—I got it —the **Mp** also heard about that—. Once again, my understanding is the next points.

- Our productions are Middle-Mixed and Middle-Volume, and High-Mixed and Low-Volume…
- Our aim is to apply these productions with no or low inventory…
- To apply it, TPS is one of the essential tools…
- To introduce it, TPS should be involved in the corporate backbone.
  ..
- And we need to make up the story (Corporate Strategy, Annual policy and Annual action plan).

—Am I right? —**Mp** asked the group.

—Very good Mr. **Mp** —the **Sm** agreed—. My understanding is also the same. So, how can we realize it?

They visited my office and informed me of their study. And then we made the following dialogue:

> After a digression (idle talk) with some of them, the **Sm** entered the meeting room very excited and outraged. And, the **Hr** asked him to come down, and then I asked: —Why Mr. **Sm** is outraged?
>
> The **Sm** mentioned very disappointed: —My department was also required to reduce staff by DOPE. It is indeed a very violent issue.
>
> …
>
> —Mr Sm —the Em commented calmly—, it is your bad habit to become emotional.
>
> —Ha, ha, ha —I laughed—. I see... However, everyone. It is not such a bad thing to express emotions…
>
> —Joy, anger, sorrow, pleasure, love, hatred, disgust, fear, anxiety, surprise... Humans experience a wide range of emotions. The presence of emotions is proof of life, and as long as we are alive, emotions will continue to exist…
>
> —Emotions are not merely reactions to events that occur; they play a crucial role in guiding our actions and decisions…
>
> —For example, anger generates the energy needed to protect oneself and what is important to us. Joy promotes a comfortable and safe state and enhances the motivation to maintain that state…
>
> —Sadness provides the time needed to accept the loss of something important and consider the next course of action. In this way, emotions serve as the mind's warning

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system, essential for human survival. However, excessive anger can cause serious problems in human relationships. It can destroy trust with others and escalate conflicts. DOPE. You are in a difficult situation. Somewhere in your heart, you understand DOPE's activities, but you cannot accept them…

—There is also a risk of verbal or physical violence. If you cannot control your anger and explode at work, you will become isolated from those around you. Holding onto anger for a long time can cause constant stress and have a negative impact on your physical and mental health. When you feel angry, you may have trouble falling asleep…

—What about sadness? — I continued—, Excessive sadness can also cause serious problems. For example, if you feel deeply sad about the loss of a family member and remain in a state of lethargy, it can have a negative impact on your health, such as causing physical discomfort. In addition, if you hold onto your sadness and distance yourself from your friends and colleagues, you will feel more lonely. What about 'joy' in the four emotions of joy, anger, sorrow, and pleasure? Even joy, which appears to be a positive emotion, can lead to a loss of self-control, an inability to make realistic judgements, and risk-ignoring behavior if it is sought after excessively. A bad example of this is cognitive bias. The joy and satisfaction of success often cause cognitive bias in the future.

—I often talk about Zen. One of the teachings of Zen is to 'live with a calm mind, without being swayed by emotions.' It's easy to understand the teaching, but difficult to put into practice, isn't it?

—In Zen, 'living' is considered to be the repetition of birth and death. Humans repeat birth and death with every breath they take. The past self has already died, and the future self has not yet been born.

—Only this very moment is the 'true life' that you are living. The accumulation of these 'moments' is what makes up life. Ha, ha, ha.

—Is it difficult? —I finally asked them before talking to Sm, particularly—: Mr. Sm and… everyone as well. Emotions are naturally arising and disappearing phenomena, not fixed entities. No matter how strong an emotion may be, it does not last forever and eventually fades away.

—Think of emotions as 'hot stones' thrown at you by DOPE. Holding onto a hot stone only causes you pain, so you should let go of it as soon as possible.

—However, if you throw the hot stone of emotion at someone else, they will get burned. Emotions arise from within yourself, but they are not your heart itself. Once you realise this, you will no longer be swayed by your emotions.

—The important thing is to control your emotions. It's difficult, but you have to control them.

—Your emotions are not your heart itself. When you feel emotions such as joy, anger, sorrow, and pleasure welling up inside you, ask yourself, 'What am I feeling right now?'

***6th Jishu-Ken* for TPS introducion**
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—Put label your emotions specifically, such as ‘I am feeling angry right now’ or ‘I am feeling sad right now.’ Put a label on your heart…

—In other words, observe your emotions from a slightly detached perspective. This allows you to objectively grasp your own emotions and view them from a bird's-eye perspective…

—The second step is to accept the emotions that are welling up within you. It is important not to deny any emotions…

—Even if you feel anger, instead of denying it by thinking, ‘I shouldn't be angry about this,’ accept it by thinking, ‘It's natural to feel angry right now.’ By accepting negative emotions as your natural reaction, you can calm down more quickly.

—Think calmly, ‘I am angry right now, but this anger will probably disappear in 20 minutes.’ Or, if you are feeling grief, think, ‘It was a sad event, but will I still be living with the same sadness a year from now?’ This will help you soften your emotions.

—You've probably heard of ‘anger management,’ right? —I asked them—. A friend of mine in the United States explained it to me as follows…

—There are several specific techniques and methods for anger management. For example, the following methods are common…

—Identifying triggers: It is important to identify the situations or factors that make you feel angry and think of ways to deal with them…

—Relaxation techniques: Learning techniques such as deep breathing and meditation to relax can help ease feelings of anger…

—Meditation? … Is that difficult? … I see. Well, your ‘toilets’ are dirty and smelly, after all —I observed and continued…

—There is a better constructive expression: ‘Rather than suppressing anger, it is important to express it appropriately’. For example, it is effective to communicate your feelings by saying, ‘I feel this way.’

—In this way, anger management is not simply about suppressing anger, but rather an important skill for understanding emotions and building better relationships…

—It's similar to the teachings of Zen, isn't it? …Do you remember? Adjusting your posture, breathing, and mind…

—Breathing. Regulate your breathing. And, I would like to introduce ‘Tanden breathing’…

> ‘Tanden (丹田)breathing’ is generally expressed as ‘Tanden breathing’ in English as well.

—This is a traditional Japanese breathing technique in which you concentrate your awareness on the ‘Tanden’ located below the navel (lower abdomen). In English, it can also be described as follows:

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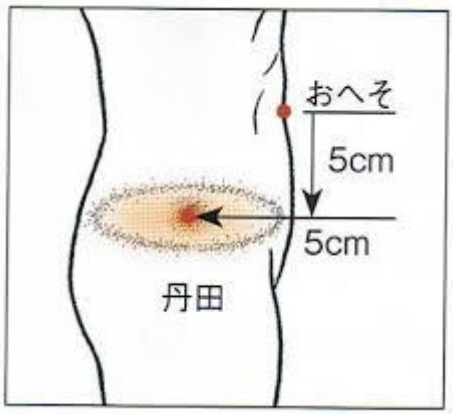
'Abdominal breathing focused on the lower abdomen (Tanden)'



—Abdominal breathing and 'Tanden breathing' are different

Features of Tanden breathing

On the other hand, Tanden breathing is a breathing method that focuses on the area below the navel, known as the 'Tanden.' In Tanden breathing, you gather air in the Tanden when inhaling and push it out from the Tanden when exhaling. This method promotes deeper breathing and strengthens the movement of the diaphragm. Additionally, Dan-ten breathing is said to have effects that promote mental concentration and inner stability.

On the other hand, abdominal breathing is a breathing technique primarily using the diaphragm, where the abdomen expands when inhaling and contracts when exhaling. This method also has relaxing effects and can help reduce stress. Abdominal breathing allows the lungs to take in a large amount of air and is said to have positive effects on both physical and mental health.

Tanden breathing also has the effect of suppressing emotional outbursts. Consciously repeat deep Tanden breathing several times. Especially when feeling anger or anxiety, Tanden breathing is effective.

There is no need for special skills to recognise, accept, and calmly address your emotions at that moment. When overwhelmed by intense emotions, embrace them firmly and gently let them go.

—So, Mr. **Sm** —then I focused my words on him—, I recommend you do Tanden breathing for very short meditation in your quiet area.

—And everyone? …What do you want to talk about?

After some Idle talk, we continued with the central theme…

The **Em** started with some serious concern: —We need to adapt the production system to the changing business

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environment. Now we can expose our conviction. It is necessary to introduce TPS…

—Or as you said, customized TPS —the **Em** recognized—. For this, we were thinking about what the necessary actions are. One aspect is the establishment of the corporate backbone, as outlined in the Corporate Strategy, Annual Policy, and Annual Action Plan. One is the organization. Fortunately, we have the Management Team's system and a monthly review. But it must be reviewed. At this time, we have no idea yet…

—One is ***Genba-Ryoku***. It may be the most challenging issue. Is our direction correct?

—Oh, I see —I recognized the challenge—. Oh! …And? What is your difficult thing?

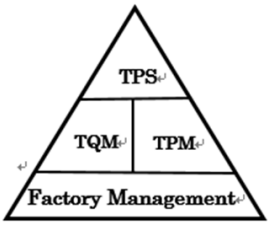
The **Hr** detailed these difficulties: —One and 2 will be discussed and fined by the entire management team. Last one. Involving Gemba and Gemba capacity. It may be the biggest hurdle.

TPS introduction and Customized TPS

—Everyone! —I call their all attention—. Please understand that TPS is a concept or thought. The products and production flow, as well as yours, are basically different. Toyota established its TPS for its production. You also need to develop a suitable TPS for your company. Please think more flexibly.

—I have been told that my previous company (SWS) also introduced TPS, and it wasn't the same as the original TPS, but customized techniques. However, the basic theory and thoughts were the same.

—It is a good thing that you intend to take TPS. But as you pointed out, this realization is a companywide activity required. You can do it. But the biggest enemy is "time".



—Can you do it within one year? …No, I don't think so. 2 years? …No, still it would be enough.

—I show you left-side picture. It hat picture the Factory management is the base. In this pyramid, there are TQM and TPS. And at the top there is TPS.

—In my teaching, TQM and TPS are included as part of Factory Management. And your position is still struggling to establish a certain level of Factory Management. Even you don't have your corporate story of strategy, annual policy and annual action plan.

—Your aspiration is good. But please discuss it internally. Please discuss it in the management team meeting first.

—After this, after deciding the corporate strategy, please come to see me to discuss the actual action plan.

Factory Management checklist MS-Excel file in Internet Archive

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—By the way —I concluded—, how was the result of the Factory Management situation by the Factory Management Checklist[6]?

The **Hr** answered such a question: —There were variabilities by the persons who checked. But it is 40 to 50%

—I see —I said, trying to search for advice in my brain. Hmm... You have many things to do if you introduce a system of factory improvement. And? …What do you want to do?

—That's why! —the **Sm** recognized—. Therefore, we wish to challenge the TPS introduction as our Production Manager mentioned.

—Sensei —the **Em** questioned me—. We planned to express our idea in the Management Team Meeting this week. And, the points are the story of Strategy, Annual Plan, Annual Action Plan and our action plan of TPS introduction.

—I see —I admitted—. But I don't want to have relevance to your plan, because, as you know, the consultancy contract is just TQM. If changing this contract, it is necessary to establish a new contract. And, I know your boat is sinking. I know you're eager. But the re-contract and corporate eagerness should be the first priority.

—How can you gain an understanding of DOPE?

The **Em** intervened: —We will speak to our Managing Director and would like to obtain your agreement to attend the Monthly Management Team Meeting. And… in this meeting, we should find and confirm the direction.

Monthly Management Team Meeting

I omit some introductory dialogue to prefer going to the central theme, when the **Managing Director** intervened, clarifying the situation:

—Everyone —he called their attention to the central theme of the meeting—, it is necessary to clarify this factory's standing position. You thought that our factory was one of the divisions of HQ. However, this plant was also required to have a self-supporting accounting (self-sustaining) system from the start. Sadly, the accumulated deficit is at a level that our Headquarters cannot support…

—Then, my mission is 2. One is to find a survival way. Or, whether it is not possible, my second mission is the so-called post-war process…

—I honestly tell you that I was worried before our Headquarters dispatched me, because I knew the situation of this factory. But when I was sent as the Managing Director of this plant, I found one light. It is you. This plant had a Management Team involving all managers. This Management Team organization affects not only the

[6] Factory Management Checklist English & Spanish: https://archive.org/details/factory-management-checklist-eng-esp-2023

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finding of solutions but also the innovative thinking of all members. The mind innovation. It is the mind of attending corporate management by all…

—Now, please let me listen to your frank opinion —the **Managing Director** finally asked them.

I omit various opinions from the managers before anything proceeds to relevant interventions, like Mr. **Sm**.

With an excited look on his face, the **Sm** intervened: —Please listen to my point of view. The three following points.

—The first one: There are markets for our products. There are! —the **Sm** insisted—. Please look at my paper, which is the marketing survey by my Sales department.

—Additionally, our products are competitive in terms of price, quality, and delivery so far.

—So, the second point is about our competence: We have a particular competence in the market.

—And the third point is —the **Sm** said with an excited face—: We have future products.

Then the **Sm** detailed his last point just a little: —As you know, our main products are the series of H, W and M. However, these will also have competitors and will become like a commodity. These are now Middle-Mixed Medium volume products. However, however ---. We are developing new future products by collaborating with Engineering, Sales, and Accounting. My department is continuing to dig up the VOC (Voice of Customer).

The **Pm** wanted to add more information: —I wish to add another point to the ones commented by Mr. **Sm**. This is the —he made a small pause and repeated—, this is just something I heard from my teacher, but… "Kare o shiri onore o shireba hyaku-sen hotondo ukarazu," or just in English: If you know your enemy and know yourself, you will not be defeated even in a hundred battles:

- 彼を知り己を知れば百戦殆うからず (The Art of War by Sun Tzu)
- 彼を知り; Know enemy.
- 己を知れば; know yourself.
- 百戦; hundred battles.
- 殆うからず; you will never be defeated in

—Now we know the enemy —the **Sm** delved deeper—. I will show you a paper that was discussed by Mr. **Af** and is our recent BS (Balance Sheet).

—Please never say that this information is commonplace.

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—By the right-side diagram, we learned many other things. But the biggest harvest was to recognize our weak point, or in other words, the biggest enemy is "Inventory (it is 180,000)".

Assets		Liabilities	
Current Assets		**Current Liabilities**	
Item	Amount	Item	Amount
Cash and deposits	10,000	Notes and accounts payable trade	110,000
Notes and accounts receivable	70,000	Short term loans payable	450,000
Inventories	180,000	Current portion of long term debt	80,000
Other current assets	10,000	Other current liabilities	40,000
Total current assets	270,000	**Total current liabilities**	680,000
Fixed assets		**Long term liabilities**	
Item	Amount	Item	Amount
Buildings and structures	120,000	Long term debt	300,000
Machinery, equipment and vehicle	90,000	Bonds payable	20,000
Land	80,000	Allowance for Pension.etc.	30,000
Other tangible fixed assets	20,000	Other Long term Liabilities	20,000
Goodwill	0	**Total Long term Liabilities**	370,000
Other intangible fixed assets	10,000	**Total liabilities**	1,050,000
Investment securities	20,000	**Total net assets**	
Other investment assets	10,000	Item	Amount
Total fixed assets	350,000	Capital stock	100,000
Total assets	620,000	Capital surplus	50,000
		Retained earnings	△580,000
		Total shareholders' equity	△430,000
		Total net assets	△430,000
		Total liabilities and net assets	620,000

And **Sm** detailed: —Inventory. It is indeed the root of all evil.

—Now it is pretty clear that our evil is "Inventory". Why is an inventory evil? …It is not only the causes of interest, space and control cost, Muda use of labour capacity, but also "loss on disposal of inventory" and the freezing of cash. If I describe the evil in just labour capacity, it is not only the direct labour but also includes material handling. Our factory is in a distorted stance.

—So, our suggestion is simple and corrects the distorted factory stance by TPS.

—Fortunately, the current Managing Director and factory manager is a professional of JIT. And he also wishes to introduce it by scheduling it in his annual action plan.

—Our suggestion is to introduce TPS.

…

— What do you think, ***Sensei***? —asked the **Managing Director**.

Suddenly, the spotlight fell on me. When I was invited to attend this meeting, I was actually participating just for fun. It was indeed an insensitive attitude (not an actual attitude, but only in the heart). Because I guessed that DOPE would fire me for the reduction of costs, it felt insensitive to me. That's how it is, isn't it? I'm not a good person. Thus, there is a proverb "Other people's misfortune tastes like honey."

A famous Japanese screenwriter says that humans have a devilish side.

For example, when breaking news reports that a passenger plane is missing, and it is later reported that it is safe, people feel relieved and think, 'I'm glad,' but at the same time, they also think, 'Oh, that's it?' Humans feel bored if they don't feel suspense. That's why dramas depict conflict and tension. No one would watch a drama where everyone gets along peacefully.

I'm not a good person, but a mean person.

And when I was imagining such a thing, suddenly, he questioned me.

—What is your question, Mr. **Managing Director**? —I asked.

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—That's what I said. How about the effect of JIT introduction? How about the possibility for us? And basically, the resolution of inventory is the solution for our plant?

—Well… —I hesitated trying to find an answer—. To resolve the issue of inventory, including its causes, is one of the biggest challenges.

—And the introduction of JIT production is also correct. However, it is the last question, the possibility is "I don't know so far. Mr. **Pm**, how was the result of the Factory Management Checklist level? What was the score? —I asked him when I already have heard about it, so my question was only to talk openly about hat.

—About 45%, between 40 ~ 50% —**Mp** answered.

—Mr. **Managing Director**, I don't want to be negative, but it seems impossible given the current factory management conditions. It is never possible to have no annual action plan by corporate strategy, annual policy. If you wish to do it, you need to start with the establishment of a corporate backbone.

— So, ***Sensei***… —the **Managing Director** asked me again, and repeated—, ***Sensei***… Your saying is that there is still a possibility.

—Possibility? Yes, you have it. Any company has the possibility of anything. And the difference is the height of the barrier. The height of the barrier serves as both encouragement and a challenge —And I spoke as if it had nothing to do with me.

—It’s a tricky one, but hang in there!

—**Sensei** —he repeated and showed a concerned face when talking to me—. It isn't the final decision. But I want to keep this idea as a condition for the continuation of this plant. My idea is to seek your help as a close consultant.

—As you already know, I visited our Headquarters and discussed the money supply. And I told them that I will make an innovation action plan. It is necessary to make it up as soon as possible. It has a time limit. In parallel, the DOPE group was dispatched. Once again —he detailed once more—, I also believe that the inventory issue, including the root cause, is a significant problem at this plant.

—Regarding the Human issue… —the **Managing Director** continued— I think and believe we have no concern. My managers are excellent. There is a proverb of "Rats desert a sinking ship". However, our managers are not such rats, and they are thinking about the solution together us…

—Actually, the managers could be personally reshuffled within the total group without being fired… This is the result of the Management Team organization.

—So, ***Sensei*** —the **Managing Director** said to me then—, as Mr. **Pm** made the presentation, is the introduction of JIT the solution to the inventory problem? And could you help us make up the action plan? …Of course, it includes the establishment of the corporate backbone (Strategy, Annual Policy and Annual Action Plan).

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Then another participant of another Jishu-ken group intervened. It as the **Quality Assurance Manager** (**Qa**): —My ***Jishu-ken*** group is studying the Lean production system. When we heard that another ***Jishu-Ken*** group was studying TPS, we chose the theme of the Lean Production system. May I have a moment of your time for my small presentation about the Lean system introduction?

—Mr. **Qa** —the Managing Director requested—. Please never mind the time. I wish to confirm our corporate direction in this management team meeting. And please go ahead.

—Thank you, sir —the **Qa** grateful and he requested to the Managing Director—. Please look at my paper. Sorry, it is not my original, but the memorandum of a dialogue with **Sensei**.

—We had prepared a paper, which is one of the papers of my US friend, who is a self-proclaimed Lean professional.

—Therefore, this paper is the ***Sensei's*** comment added to my US friend's.

—Initially, our discussion with ***Sensei*** was the ***Gemba-Ryoku*** issue. **Sensei** questioned us: Do we know your ***Genba***? …

> Conversation in the second ***Jihsu-ken*** group working session was talking about ***Genba-Ryoku***. The following sentences are my dialogue with them.
>
> —We answered "yes ,we know". But why? —the **Qa** questioned me.
>
> —I see —I understood—. Everyone, please understand the following words: A person who cannot read data, it's out of the question. A ***Genba*** who has no data, it's also out of the question.
>
> —But, a person who only looks at data is even worse.
>
> —Everyone. Nowadays, the preparation of KPIs and data gathering systems is almost established. However, I need to say another word: A person who does not take action based on the data is the worst.
>
> —For instance, quality costs such as defect disposal or repair costs.
>
> —The defect ratio by number of defective cases is declining.
>
> $$Defect\ ratio\ = \frac{Defective\ lots}{Total\ number\ of\ production\ lots}\ x\ 100$$
>
> —But the quality cost is increasing.
>
> —How do you read the situation of Gemba? …Your company hasn't changed a bit. Produces many, stocking many, disposing many, repairing many.
>
> —Stop excess production. Excess or not, it depends upon the forecast or actual receiving order.

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—***Genba-Ryoku***: It is the capacity to understand and take action. A company is established with 3 factors. One is organization (Such as the Management Team, meeting system, etc), one is data (KPIs), and one is **Genba** (***Genba Kaizen*** organization, Data gathering, 5Ss and Safety).

—These 3 factors haven't been combined yet.

...

Back to the management meeting and the exposition from **Qa**:

—Then, the dialogue was transferred to the excess production and inventories. And I questioned how the introduction of the Lean production system resolves the problem of excess production and inventory.

—But ***Sensei*** answered nothing, but told us "study by yourself".

—Then we got the next knowledge from my US friend and SNS. The following is its outline:

The differences between TPS and Lean.

As I told you before, we frankly added ***Sensei's*** comments to the paper. In this paper, the underlined words and … are the suggestion of ***Sensei***.

Next is the outline of his presentation. The theme: *Toyota Production System (TPS) vs. Lean Production System (LEAN): Key Differences from the US Perspective*

<u>Historical Context and Origins</u>

Toyota Production System

- **Origin:** Developed organically by Toyota from (Taiichi Ohno) 1940s-1970s.
- **Context:** Post-WWII Japan, resource constraints, need to catch up with US productivity
- **Philosophy:** Company-specific culture deeply rooted in Japanese business practices. It's entirely a matter of Toyota's corporate culture.

LEAN

- **Origin:** Coined by MIT researchers in 1988 (John Krafcik, James Womack)
- **Context:** US study of Japanese manufacturing superiority in the 1980s
- **Philosophy:** Westernized, universalized version of TPS for global application
- **Publication:** "The Machine That Changed the World" (1990) popularized the term

<u>Fundamental Philosophical Differences and Cultural Foundation</u>

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Toyota Production System:

*I saw many companies that intended to introduce the Toyota production system. But the success stories are almost nonexistent because they didn't consider and understand the cultural differences. Nowadays, TPS and Laen are no different in a limited area. Then it is possible to say that Lean is one of the customized ones. But its customization is insufficient in the **Gemba-Ryoku** aspect.*

- Embedded in Japanese cultural values (respect, long-term thinking, consensus-building)
- Emphasizes "respect for people" as core philosophy
- Built on lifetime employment and strong company loyalty
- Focus on collective responsibility and group harmony

Lean:

- Adapted for Western individualistic culture
- Emphasizes tools and techniques over cultural transformation
- Designed for a diverse workforce and shorter employment tenures
- Focus on measurable results and efficiency metrics

<u>Implementation Approach</u>

Please remember this phrase. And... comparing to Lean tools.

Toyota Production System

- **Holistic System:** Integrated philosophy covering entire enterprise
- **People-Centric:** Focuses on developing people to solve problems
- **Long-term Perspective:** Decades-long cultural evolution
- **Organic Growth:** Evolved naturally within Toyota's specific context

This context is somewhat outdated in present-day Japan. Nowadays, TPS is being customized by individual companies based on the corporate culture and business types. In this sense, TPS is also close to Lean, as it maintains the basic TPS thought or philosophy.

LEAN:

- **Tool-Based Approach:** Emphasis on specific methodologies and techniques
- **Process-Centric:** Focuses on eliminating waste in processes
- **Quick Implementation:** Designed for rapid deployment across industries
- **Standardized Package:** Consultant-driven, one-size-fits-all solutions

<u>Content and Methodology Differences</u>

Waste Identification

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TPS:

- Original 7 types of waste (Muda)
- Integrated with Mura (unevenness) and Muri (overburden)
- Contextual understanding of waste within Toyota's operations
- This short sentence may give a misunderstanding. There is a word of 3Ms, which are Muri, Mura and Muda.

Muda: *Waste itself also has an essential definition: 3Ms; Muri, Mura and Muda.*

There are 3 types of Mudas. Each has a different meaning. The Toyota Production System has so many unique words. I listed some typical words (including Muri, Mura, and Muda) to understand the TPS culture next.

Toyota words:

Japanese Term	Literal Meaning	English Equivalent	What it is.
Andon	Paper lantern (comes from the use of traditional lighting equipment using a fire burning lamp made out of paper and bamboo)	Help Button(Chord)	A very simple, but powerful system where a front line employee can signal for help. Pushing a button or pulling a chord illuminates a light and/or triggers an audible alarm. The employee's team leader is then expected to attend to provide assistance in a specified period of time.
Gemba	The actual place or "the scene of the crime"	The actual workplace	A name for the place where value is created in your business – whether it be an office, a factory floor or an operating theatre.
Gembutsu	The actual thing.	The real thing.	The actual work being done as seen first hand.
Genchi Gembutsu	The actual thing in the actual place	Go and See	The need for leaders in business to get out of their offices and actually go to the workplace to see how the work is done rather than relying on reports and second hand information.
Hansei	Reflection/ contemplation	Self reflection	A person actually reflecting on their own performance and taking responsibilities for their own shortcomings and problems they have caused.

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Heijunka	Levelling	Load Levelling	Adjusting production across a number of processes so that they all work at a level rate (equal to Takt Time)
Hoshin Kanri	Ho" meaning method or form and "shin" meaning shining needle or compass. "*Kanri*" means management or control;	Policy Deployment	A process by which business strategy is propagated through the functions and levels of an organisation. Ensures strategic alignment and allows for feedback back up the organisation on strategy.
Kaikaku	Reform	Revolutionary change	Achieving improvement through big revolutionary changes.
Kaizen	Improvement	Continuous improvement	A process of evolutionary change for the better through small steps over time.
Kanban	Signboard or billboard	Pull System	A system whereby inventory is replenished and production scheduled based on replenishing usage rather than by making a forecast. Returnable "Kanban cards" are often attached to inventory containers and then detached and returned to trigger replenishment when the inventory has been consumed.
Muda	Useless, wasteful	Waste	Any non-value added activity, or material.
Mura	Uneven, irregular	Unevenness	Excessive variation in a process or in customer demand.
Muri	Impossible or unreasonable	Overburden	Overloading a process or people in a process.
Nemawashi	Going around the roots	Consensus building	The process of building support for change by sharing it with people and gaining their input.
Poka Yoke	Error proofing	Error Proofing.	A device that prevents errors in a process. This might be a fixture that prevents mis-assembly, but can also be an office routine that prevents the operator making a simple mistake.
Yokoten	Across everywhere	Horizontal sharing	Sharing learnings across the organisation, between locations, functions and even divisions. Both the learning and the process by which the

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			learning was obtained is shared.

These are only a small portion. To understand the TPS culture, it may be beneficial to introduce these special words.

TPS's 7 Wastes.

1. Processing waste
   Using resources that do not directly contribute to the completion of the actual work. Examples include excessive processing and unnecessary inspections.
2. Inventory waste
   Holding unnecessary inventory and supplies. Excessive inventory increases storage costs and leads to wasteful use of funds.
3. Overproduction
   Producing more than necessary without planning, or manufacturing too early. This increases inventory and wastes resources.
4. Waiting waste
   Unnecessary downtime or idle time. This disrupts the workflow and reduces efficiency.
5. Motion waste
   Movements that do not add value. Examples include unnecessary movement or unnecessary work.
6. Transportation waste
   The flow of goods or information that does not add value. Unnecessary transportation wastes time and money.
7. Defects and rework waste
   Producing defective products or performing work that requires rework. This leads to rework and reduces efficiency.

LEAN:

Expanded TPS wastes to 8+ types of waste:

8. Added "unused human creativity": Some sources identify up to 24 types of waste:

Standardized waste categories for universal application Based on the seven basic types of waste identified by TPS, it will introduce representative patterns that have been broken down into 24 types of waste.				
#	**Classification**	**#**	**Type**	**Details**
1	Processing waste	1	Excessive quality	Processing with higher precision or specifications than necessary
		2	Improper processing sequence	Unnecessary setup changes or rework
		3	Inappropriate equipment selection	Inefficient use of machinery with excessive capacity
		4	Processing errors and rework	Reprocessing or corrections due to defects

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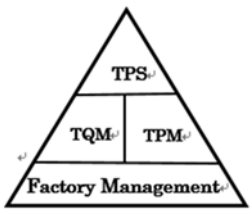
2	Inventory waste	5	Work-in-process (WIP) backlog	Accumulation of WIP hinders workflow
		6	Excess inventory	Holding unnecessary parts or materials
		7	Inventory deterioration/loss	Quality degradation due to long-term storage, inventory discrepancies
		8	Inventory storage space	Increased area and management costs for inventory
3	Motion waste	9	Unnecessary movements	Unnecessary physical movements (reaching, searching, etc.)
		10	Searching and waiting movements	Searching for tools or documents, waiting for your turn
		11	Movements for transportation	Unnecessary movements for moving between processes
4	Transportation waste	12	Excessive transportation	Transportation over excessive distances or too many times
		13	Inappropriate transportation methods	Inefficient methods such as using carts that are too large
		14	Transportation waiting time	Time spent waiting for transfers or your turn
5	Overproduction waste	15	Batch production	Overproduction that burdens subsequent processes
		16	Speculative production	Production that does not match actual demand, leading to increased inventory
		17	Unplanned production	Production that ignores setup and flow
6	Waiting waste	18	Setup waiting	Waiting for other tasks to be completed
		19	Material waiting	Work stops due to parts not arriving
		20	Waiting for instructions	Work stops until instructions are received
7	Defect waste	21	Initial defects	Quality defects immediately after completion
		22	In-process defects	Defects occurring at intermediate stages
		23	Complaint and return handling	Costs incurred due to customer complaints about defects
		24	Excessive quality control	Unnecessary inspections and verification tasks

…By Felo Search

Tools and Techniques

TPS-Specific

- Material and Information Flow Analysis (MIFA)---This description is too poor.
- 4S (not 5S)
- Company-specific kanban systems



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- Toyota-style problem-solving methods (Probably, it is the meaning of 5Whys. And it is not a method, but the thought)
  This explanation is too insufficient. For instance, ***Heijun-ka***, **Andon** etc. etc. are missing. There are too many missing. Next is PQCD instead of MIFA.)

  Example of PQCD

PROCESS QUALITY CONTROL DIAGRAM – PQCD DATE: _____/___/___

Team		Product:		Actual Page / Total Pages
1		Version No:		
2		Comments:		
3				
4				
5				
6				

Proces No: / ISSUE:	1	2	3	4	5	6	7
PROCESS PICTURE							
DETAILED JOB							
POINT OF QUALITY							
SPECIFICATION							
INSPECTION METHOD							
INSPECTION TOOL							
ANNOTATION							

Are the purposes of PQCD and MIFA[7] different? … I know, but I'm telling you 2 things: These are the fully utilized, minimized practical methods, and the process of devising and customizing them. And regarding the Value Stream Mapping? Is that useful?

LEAN additions

Value Stream Mapping (VSM) - more prominent than MIFA

5S

Added 5th S: "Sustain/Self-Discipline", but it is wrong. So the 5th S is ***Shitsuke****: Education.*

It's also customized in Japan. SUMITOMO uses 6Ss, added ***Shucan:*** *Habit)*

[7] **MIFA vs VSM:** "*The main difference is that Material and Information Flow Analysis (MIFA) is a more detailed and specific type of analysis that can be used in the design phase, while Value Stream Mapping (VSM) is a broader Lean tool used to visualize and reduce waste in existing processes from raw materials to finished goods. In essence, MIFA can be considered a more granular or a precursor version of VSM, as VSM is a simplified representation of the flows that MIFA can provide a more in-depth look at, especially for new product launches or specific parts of a supply chain.*" ***By Gemini***

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Kaizen Events

Kaizen events are not used at Toyota and the meaning is unknow for me.

Six Sigma integration (Lean Six Sigma)

This US friend's report shows the cultural difference between Toyota and US society. The US has difficulty with Bottom-Up and "All people's participation". But its recognition is wrong when viewed from the workers' perspective. There are 3 facts. One, Genba workers likes Kaizen activity. 2. But it also a fact very high turnover ratio. 3. Manager choses Top-down and/or Project style rather than to be hassle "All people's participation".

Is your corporate culture US like, or Japanese like? Or?...

Kata methodology

X-Matrix for ***Hoshin-Kanri***

US Thinking and Adaptations: Once again, the base is factory management. TPS is based on the condition of existing a certain level of factory management. Lean system is different. It involves to make condition of factory management.

American Business Culture Influence

Quarterly Results Focus:

- Lean adapted for short-term performance measurement.
- Emphasis on quick wins and visible improvements
- Financial metrics prioritized over cultural development

Consultant-Driven Approach:

- External expertise model vs. internal capability building
- Standardized training programs and certifications
- "Plug-and-play" methodology packages

It is amazing! Plug-and-play methodology!? …Is this Lean? …

Do you understand the meaning of "Plug-and-play"? …

The basic meaning by dictionary: Plug = to insert. Play = to use or operate immediately → 'Once inserted, it can be used immediately' = a system that can be used immediately.

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As you understand, the introduction of Lean, even TPS, cannot be easy or plug-and-play. Top-down or project style, such as Lean Six Sigma. I never deny it. But please never forget Gemba, who is the main actor. Top-down and project. These are good. However, please, never forget the after; never forget the new culture stabilization if you don't want these to end just as a festival.

Plug-and-play method? …Ridiculous!

Consultant… I am also a consultant, but what? …You must have the capacity or knowledge about the problem (your requirement) and techniques to resolve it. You need to have and cultivate a critical eye.

Individual Performance Culture:

- Modified to work with performance-based compensation
- Emphasis on individual accountability vs. team responsibility
- Adapted for high employee turnover environments

MIT Study Impact

Academic Systematization:

- Rigorous documentation of TPS principles
- Creation of teachable methodology
- Development of universal principles applicable across industries

Benchmarking Approach:

- Comparative analysis with traditional mass production
- Quantitative measurement of efficiency gains
- Scientific validation of lean principles

Implementation Challenges in US Context

Cultural Barriers

Management Resistance:

- Top-down implementation without leadership transformation
- Delegation of lean to lower levels without executive engagement
- Lack of long-term commitment to cultural change

Workforce Scepticism:

- "Lean" is associated with layoffs and cost-cutting
- Resistance to a continuous improvement culture
- Lack of job security affecting buy-in

Structural Differences

Labour Relations:

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- Adversarial union-management relationships vs. collaborative approach
- Different employment contracts and expectations
- Varying skill development approaches

Organizational Structure:

- Hierarchical command-and-control vs. flat decision-making
- Functional silos vs. cross-functional teams
- Different communication patterns

Success Factors and Limitations:

- US Lean Successes
- Rapid deployment across diverse industries
- Measurable operational improvements
- Systematic training and certification programs
- Integration with other improvement methodologies

Common Failures:

- High Failure Rates: 50-95% of lean implementations fail
- Lack of Sustainability: Improvements regress over time
- Tool Focus: Emphasis on techniques over culture change

Context Ignorance:

- Copying solutions without understanding context

Current Evolution:

- Hybrid Approaches
- Recognition of need for cultural adaptation
- Integration of TPS philosophy with lean tools
- Emphasis on developing internal capabilities
- Focus on leadership development
- Industry-Specific Adaptations
- Healthcare lean
- Software development (Agile/Lean)
- Service industry applications
- Government sector implementations
- Key Insights for US Implementation

<u>Critical Success Factors:</u>

- Leadership Commitment: CEO and senior management engagement
- Cultural Sensitivity: Adapting to local organizational culture
- People Development: Investing in capability building
- Long-term Perspective: Viewing lean as a journey, not a destination
- Context Awareness: Understanding the specific operational environment

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Recommended Approach:

- Start with pilot programs in specific areas
- Develop internal lean leaders rather than relying solely on consultants
- Focus on principles and thinking, not just tools
- Adapt methodologies to organizational culture
- Measure both operational and cultural improvements

The fundamental difference is that TPS is a cultural system while Lean is a management methodology.

This thought is wrong. TPS is one of the technical structures designed to improve corporate culture.

US thinking has been to systematize and package TPS principles into teachable, scalable tools, but this has sometimes lost the profound cultural transformation that makes TPS so effective at Toyota.

—I finished my presentation —the **Qa** concluded his long presentation—. So, our recommendation is to implement the LEAN system while considering the weak points and customization.

—***Sensei*** —the Managing Director asked me directly—. What is your opinion? Which is better for us, the TPS or the LEAN system?

After thinking for a while: —Everyone —I called their all attention—. Let's treat a little. TPS & LEAN. Techniques. Fundamental condition and Culture difference…

—This report and presentation are excellent. And, you could understand the outline differences. The basic concept is the same. Long days ago, when LEAN was introduced in the world, a wrong understanding was spread. One is the TPS and LEAN systems are the same.

—Wrong! —I expressed firmly—. For instance, the LEAN system didn't have the concept of ***Jidou-ka***. TPS has 2 pillars of fundamental concepts. One is ***JIT***, and the other is ***Jidou-ka***.

—Now about the techniques —I detailed—. For instance, ***Kanban***. TPS had so many kinds of ***Kanban*** systems. These are for Toyota's line conditions. But there is a fundamental condition. Once again, TPS is based on a factory management condition that supposedly already exists, as the LEAN system is also the same. However, many parts are missing.

—Now, your question. Which model is better for you? —I asked figuratively.

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COOPERATING TO REACH EXCELLENCE

—The problems are the Inventory and the causes. Then you focus on JIT. But please understand that JIT is a mindset and not just a technique. And TPS includes techniques such as a Pull-system by **Kanban**, Choro-Biki for small lot preparation, and ***Heijun-ka*** for production planning, etc. But please understand one point: You must establish the specific level of factory management, even though the LEAN system.

—X-Matrix for ***Hoshin-Kanri***? —I asked figuratively—…Very sorry, but… Can you build a tower in sand? Your score on the factory management checklist is 45%. Please establish a certain level of factory management condition. The target score is more than 75%.

—Sensei —the **Qa** then questioned me—, is this the way of LEAN system introduction, isn't it?

—Good point Mr. **Qa** —I recognized him—. If you like to call it LEAN-System Introduction. You feel free to call it.

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IV. Following Lecture

We start talking about the Total Quality Management (TQM) introduction. And, the TPS introduction in the ***Jishu-ken*** group.

Koichi Kimura, CC4 – October – 2025

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V. Annex A: Working with an "AI-colleague" to develop a Potential Problem Map using the KJ-Method

In the last lecture, we faced a problem in an industrial process. We conducted an exercise to move away from initial assumptions and numerical analysis before studying the entire process and identifying possible root causes. This process study and initial hypothesis can be explored throughout the KJ-Method.

However, sometimes we don't have the right team, and we are ultimately responsible for identifying potential root causes and designing experiments to validate our hypothesis. This situation will become increasingly habitual due to the AI's assistance. Now we can invite some AI virtual colleagues to help us and confidently confront ideas and perspectives, as they become experts in the matter due to the incredible amount of information this AI system can handle. Thus, the **solo-KJ-Method**[8] will be much more usual than we think.

The content of this lecture is about developing a **solo-KJ-Method** together with an AI colleague. In this case, we use the Google AI Studio.

The first step is to prepare a text file that describes the industrial process, includes information about the raw materials, the controls we already have on the process, and the data we can gather, the people interactions and, if possible, a flowchart or a Material and Information Flow Analysis (MIFA, from Toyota). The more information we have, the better the results we can get. In the following lectures, we can also study the design of the MIFA using the same AI tools.

However,… Creativity is still required to give some clues and context to our AI colleague. At the end of this Annex, we delve deeper into the creativity process, and in the following lectures, we explain how to train our brain for creativity based on the latest scientific studies[9]. Thus, the more creativity you have, the more creativity the AI will have. This is a fact: if you give stupid and impossible ideas as an example, the AI will provide you with more ridiculous and impossible ideas. And sometimes, this is the creative process in a storm of ideas when meeting with colleagues.

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[8] **Solo-KJ-Method, note from Eduardo L. Garcia:** Kimura Sensei asked me to reinforce the training in the following lectures using the KJ-Method in this and the next Annexes. For me, making a solo-KJ-Methd or a solo-whatever is an easy job.
However, I know that for many people, such a solo creative job is not so easy. Working alone and considering all the possible aspects of a task is challenging. And "solo work" often leads to overlooking many elements that a group can address, because the sum of 1+1+1 working in a storm ideas session is not 3 but nearly 5.
That's the main reason to conduct this solo-KJ-Method training together with an AI colleague. In this case, I used Google AI Studio, but any system can work properly as well, using a similar script as exposed here.
[9]Why You Need to Practice Divergent Thinking:
https://www.psychologytoday.com/us/blog/adventures-in-divergent-thinking/202006/why-you-need-practice-divergent-thinking

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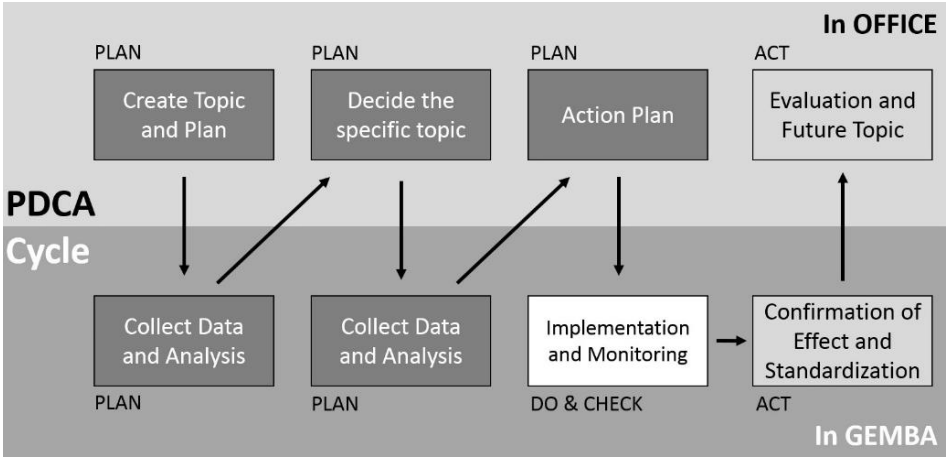
The Industrial process

The industrial process includes the following steps. It is a batched chemical process involving water dilution, carried out in two parallel lines: L1 and L2:

a) **Preparation:** Dilution of the mixture (common to L1 and L2)
b) **Forming L1** and **Forming L2**
    a. Shaping the shape by filtering the dilution into the moulds.
    b. Pressing 1
    c. Pressing 2
c) **Transport/Conveyance** and preparation for post-processing
    a. Initial process: Transport, manual sorting, and acclimatization (common).
    b. Automated process: Transport and acclimatization (L1 & L2).
d) **Post-processing L1** and **L2**
    a. Step 1..4
    b. On-the-line artificial-vision validation.

We will describe the process in more detail later to give the AI all the information it may need to do a better job. For now, it is enough.

The TQC perspective by Kimura *sensei* – Scientific thinking and method of the quality control group:



We resume the step already developed in the last lecture when we defined some ideas gathered by us (me in this case):

b. **STUDY OF POTENTIAL FAILURES:**
    i. **KJ METHOD:** The method for developing these diagrams would be the same as that used to create the Potential Problem Map (PPM), which Kimura ***Sensei*** described to us in his lectures using the KJ method. The fishbone format is valid, but not the only one. A traditional mind map, as used by Kimura Sensei in his KJ charts, is a good option. And also it is good to represent the potential causes or causes that generate the effect (the effect in the centre of the map).

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Process to use KJ-Method

KJ Method applied to this problem (AI Integration for ***solo***-KJ Method):

1) **Create Ideas or Cards** (in a group and without criticism)
    a. We ask the AI to: Expand the cards as if we were colleagues in a work group.
2) **Group the cards by topic** (by consensus)
    a. We ask the AI to group them into different categories.
3) **Eliminate redundancies** (by consensus)
    a. We ask the AI to eliminate redundancies or group very similar cards, if applicable.
4) **Reorder and Weight or Prioritize** (by consensus)
    a. We ask the AI to prioritize according to our criteria.
5) **Add more cards** (in a group and without criticism)
    a. We ask the AI to make an extra effort to imagine other causes, group them, and eliminate redundancies again.
6) **Classify the hypotheses to conduct experiments** (by consensus)

We also provide this information to the AI system to give it a process to follow and a result to deliver.

Working peer to peer with the AI to build a PPM.

We will use Notebook-LM and Google AI Studio. To build this Potential Problem Map (PPM) I prepared a PDF file to give the following: Detailed Industrial process, the KJ-method steps, The Effect of the problem, the Target of the exercise, and the cards already ideated.

STEP 1: Giving context:

- ***You are a QA responsible for working with me to identify the root cause of a problem in a chemical industrial process. We will use the KJ-Method, as described in the attached file, with 6 steps. We are first searching for cards that suggest possible root causes of the problem.***

…Include the image of the text file of the KJ-Method and the industrial process described in the previous points.

- ***I provide the process steps in the attached file, along with the raw materials and additional information about the industrial context (the industrial process is described at the beginning of the chapter). The more you give, the better results you get from the AI.***

…Unfortunately, due to the confidential information I'm using, I cannot provide more specific context in this lecture.

- ***I give you some of the root causes I figured out. To make it possible, give me other possible root cause cards. Later, we can group them into categories. Everything is attached in the PDF file.***

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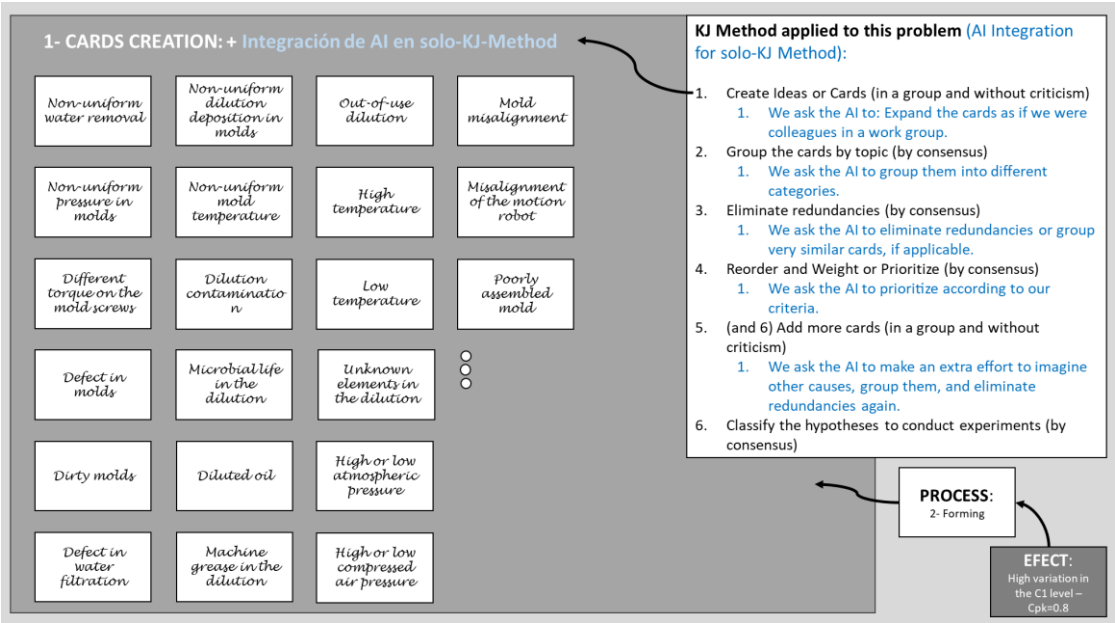
This "solo" exercise gives a lot of context to the AI colleague. It is necessary to make a special effort because the AI is producing a lot of information that may not align with your point of view if you do not provide some clues, as previously mentioned. The more the better, but I know it isn't easy if you are not an expert in the process.

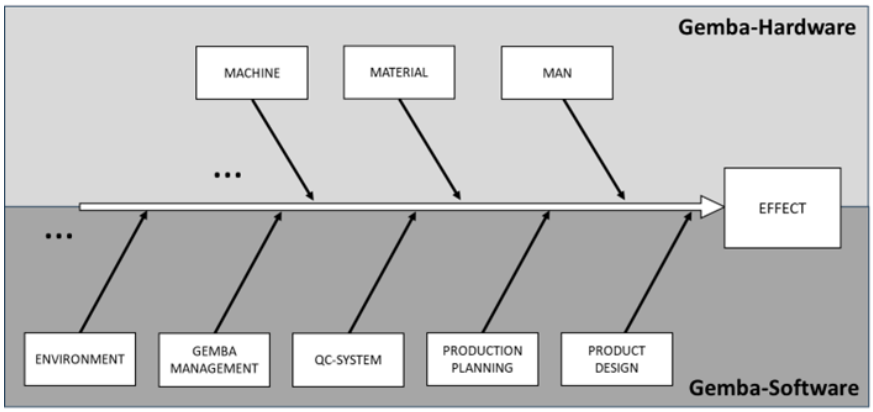
We will come back to speak about the "solo-KJ-Method" at the end of this chapter.

Giving some possible root causes is a first: "solo-KJ-Method"



- ***I want to try the complete KJ-Method exposed method by yourself. That is, execute the KJ method as described in the document, and I want you to present the three most important hypotheses. Also, a list of the causes you consider and the ones I have considered, grouped by process. Focus only on steps 1 and 2 of the process to determine the root cause of the problem. I want a summary document that explains the method and trains operators to test the hypothesis with the highest probability of occurrence. I will transfer this document to Notebook-LM to create a training video:***

Gemba-Hardware & Software as an alternative classification for Cause & Effect Diagram



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The answer comes incredibly quickly and is very detailed:

Google AI Studio with Gemini 2.5 Flash answer:

Okay, … covering the KJ-Method execution for Steps 1 and 2, the three most important hypotheses, the consolidated list of causes, and the summary document for operator training.

Execution of the KJ-Method (Focused on Industrial Process Steps 1 & 2)

Problem: *The cup height Cpk is 0.8 (other measurements ~2.0). This indicates a consistency problem in the height of the Nespresso cup.*

KJ-Method Phases to be executed:

1. ***Idea/Card Generation:*** *Generate all possible causes, combining yours and mine.*
2. ***Affinity Grouping:*** *Group the cards by logical themes, using Ishikawa categories as an internal reference.*
3. ***Redundancy Elimination:*** *Consolidate and refine the cards.*
4. ***Reordering and Prioritization:*** *Identify the most probable hypotheses.*
5. ***Adding More Cards (if applicable):*** *Further refine and expand.*
6. ***Classifying Hypotheses for Experiments:*** *Detail the top 3 most important ones.*

Industrial Process Steps 1 & 2: Relevant Context[10]

Step 1: Preparation: Dilution of the mixture (common to L1 and L2)

- *Paper-pulp, dilution similar to other paper industries.*
- *Refining is part of the process.*
- *Dilution deposited in large tanks until the next batch.*
- *Mean temperature: 15-25°C (depends on external temperature).*
- *50 meters separation from Forming.*
- *Dilution slowly warmed in tubes to the Forming Machine.*

Step 2: Forming L1 and Forming L2.

- *Proprietary XXX technology*[11]*.*

2.1) Shaping: *Filtering dilution into molds by vacuum + gravity.*

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[10] Al this data, steps and context are given in the attached document to the prompt.
[11] Company Name and technology hidden for confidential reasons; however, it is relevant to give this information to the AI to give as much context as possible.

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- *Water is not thermo-controlled, temperature depends on the controlled environment.*
- *Dilution stable: 30-40°C.*
- *Molds: 9 cavities, 9 molds/step.*
- *Mold temperature: 50-60°C.*
- *Microorganisms in dilution; cleaning every 72h.*

2.2) Pressing 1: *Water removal by pressure (vaporization). Molds with holes.*

- *Parts moved by the anthropomorphic robot in 9 sets.*

2.3) Pressing 2: *100% water removal. 9 sets of 9 cavities. Subjected to gravity during visual inspection.*

Consolidated List of Possible Causes (Grouped by Process Step and Ishikawa Category)

(Combining your cards, my cards, eliminating redundancies, and adding new relevant ideas for Steps 1 & 2)

0. OVERARCHING / GENERAL CAUSES (applicable to Steps 1 and 2):

- ***Material:***
  - ***Raw Material Batch Quality Variation (Paper Paste):*** *Inherent inconsistencies in paper paste properties (fiber, density, moisture) before dilution.*

- ***Man (Human Factors):***

  - ***Inadequate Operator/Technician Training or Skill:*** *Inconsistent execution of critical tasks (e.g., sensor calibration, mold assembly, fine adjustments).*

- ***Gemba Management (Process Management/Method):***

  - ***Insufficient Monitoring of Critical Parameters:*** *Control points or frequency of monitoring for key variables (temperature, viscosity, pressure) are inadequate.*
  - ***Incomplete or Unfollowed Standard Operating Procedures (SOPs):*** *Lack of standardization in key operations impacting consistency.*

- ***Measurement:***

  - ***Measurement System Error (MSA):*** *The tool or method for measuring cup height is not precise or repeatable enough, affecting Cpk reliability.*

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1. STEP 1: PREPARATION (Dilution of the mixture)

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- ***Machine:***
    - ***Malfunctioning Agitators in Dilution Tanks:*** *Fail to mix uniformly, causing concentration gradients.*
    - ***Defective or Uncalibrated Tank Sensors:*** *Incorrect readings for temperature, level, flow, or concentration.*
    - ***Piping Obstruction or Build-up:*** *Restricts flow, alters composition, or affects heating of the dilution en route to Forming.*
    - ***Defect in Water Filtration:*** *Allows particles or impurities to pass, affecting dilution properties.*

- ***Material:***
    - ***Inaccurate/Inconsistent Dilution Ratio:*** *The water-to-paper paste proportion varies.*
    - ***Inconsistent Water Quality (for Dilution):*** *Changes in pH, hardness, minerals, or solids affecting dilution rheology.*
    - ***Inconsistency in the Refining Process:*** *Failure to achieve uniform fiber homogenization.*
    - ***Flocculation or Settling of Dilution in Tanks/Pipes:*** *Dilution loses homogeneity due to insufficient agitation or excessive resting time.*
    - ***Dilution Contamination:*** *Introduction of unwanted substances.*
    - ***Excessive Microbial Life in Dilution:*** *Alteration of material properties.*
    - ***Dilution Past Useful Time:*** *Degradation or property change due to prolonged waiting time.*
    - ***Unknown Elements in Dilution:*** *Presence of unidentified substances altering the mixture.*

- ***Environment:***
    - ***Temperature Gradients in Tanks:*** *Hotter or colder zones in large dilution tanks.*
    - ***Inconsistency in Slow Warming Rate:*** *Dilution fails to uniformly reach target temperature before Forming.*

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2. STEP 2: FORMING L1 and L2 (Shaping, Pressing 1, Pressing 2)

- ***Machine:***
    - ***Physical Defects or Subtle Wear in Molds:*** *Micro-damage, scratches, corrosion, or wear altering cavity geometry.*
    - ***Misaligned or Poorly Assembled Molds:*** *Do not close correctly, causing leaks or deformation.*
    - ***Anthropomorphic Robot Misalignment:*** *Inconsistent positioning of parts between pressing steps.*
    - ***Dirty Molds/Residue Build-up:*** *Material accumulation in cavities or drainage holes, affecting formation and pressing.*
    - ***Non-uniform Pressure in Molds / Pressing Pressure Variation (P1 & P2):*** *Applied force is not homogeneous across 9 cavities or fluctuates over time.*

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- ***Inconsistent Torque on Mold Screws:*** *Affects mold closure and integrity.*
- ***Vacuum System Fluctuations:*** *Inconsistent vacuum for filtering, affecting material quantity and distribution.*
- ***Mold Clamping Force Variation:*** *Inconsistent pressure with which molds close or are held together.*
- ***Hole Clogging in Molds (Pressing 1):*** *Hinders uniform water removal.*
- ***Steam Trapping in Molds (Pressing 1):*** *Prevents uniform material contact with the mold.*
- ***Uneven Heating Elements in Molds:*** *The 50-60°C temperature is not maintained homogeneously across the mold surface.*

- ***Material:***
  - ***Dilution Viscosity/Density Inconsistency (at point of Forming):*** *The dilution reaching the molds does not have uniform properties.*
  - ***Non-uniform Dilution Deposition in Molds:*** *Material is not distributed evenly in cavities.*
  - ***Machine Oil or Grease in Dilution:*** *Contamination altering dilution properties.*

- ***Environment:***
  - ***Non-uniform Airflow in Controlled Environment (Forming):*** *Affects mold temperature or initial drying rate.*
  - ***Non-uniform Mold Temperature (caused by environment or control system):*** *Deviations from 50-60°C.*
  - ***Inconsistency in Cooling Rate (after pressing):*** *Affects dimensional stability of the cup.*

- ***Gemba Management (Process Management/Method):***
  - ***Inconsistent/Ineffective Mold and Piping Cleaning:*** *Accumulation of residues or microorganisms.*
  - ***Non-uniform Water Removal:*** *Pressing process does not extract water homogeneously.*
  - ***Inconsistent Vacuum/Pressing Parameter Setup:*** *Variations in adjustments between shifts or batches.*

The Three Most Important Hypotheses (with Highest Probability of Occurrence)

Based on the nature of the problem (cup height Cpk), the process description, and common issues in moulding and forming processes, the three most probable hypotheses impacting cup height are:

1. ***Variation in the Consistency of the Dilution Entering the Mold:*** *This is fundamental. If the 'raw material' forming the cup is not consistent in viscosity, density, or particle distribution when it enters the mold, the final height will be*

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variable. This encompasses sub-causes like initial dilution, refining, mixing, and transport.

- *Key Cards: Dilution Viscosity/Density Inconsistency (at point of Forming), Inaccurate Dilution Ratio, Malfunctioning Agitators, Flocculation or Settling, Inconsistent Water Quality.*

2. ***Inconsistencies in Molding/Pressing Pressure (P1 and P2):*** *Once the material is in the mold, how it is compacted and dewatered is critical for its height. If pressure is uneven across cavities or fluctuates over time, the result will be variable cup height.*
   - *Key Cards: Non-uniform Pressure in Molds / Pressing Pressure Variation (P1 & P2), Mold Clamping Force Variation, Hole Clogging in Molds, Non-uniform Water Removal, Inconsistent Pressing Parameter Setup.*
3. ***Physical and Thermal State of the Molds:*** *The mold is the template. If the mold itself has defects, wear, is dirty, or its temperature is not uniform, the final geometry of the cup will be affected, including its height. Temperature is vital for 'Shaping' and water removal.*
   - *Key Cards: Physical Defects or Subtle Wear in Molds, Misaligned or Poorly Assembled Molds, Dirty Molds/Residue Build-up, Uneven Heating Elements in Molds, Non-uniform Mold Temperature.*

… (no included in this lecture)

Summary Document for Exposure and Operator Training

This document is designed to be the basis for a training video using NotebookLM, explaining the KJ-Method and, most importantly, how operators can help validate the most probable hypothesis. I will focus on ***Hypothesis 2: Inconsistencies in Molding/Pressing Pressure****, as it lends itself best to direct verification and action by the production team.*

Thus, in the following lecture, we will explore the tools needed to develop experiments and train frontline workers and quality officers, utilizing our new AI colleague. The results I got for now are not so satisfactory from my point of view, so I ned to improve my technique in this regard.

Conclusion of this AI experiment

We can see that the three most relevant root causes gathered by our analysis align with the actual root cause we discovered in real life, as shown in the previous lecture (remember, we found a thermal picture which reveals differences in the amount of water removed by the moulds in Step 2 of the process). So, the height is affected due to this cause. Thus, the root

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causes prioritized by our AI colleague are incredibly accurate. Moreover, the experiments are already redacted in the answer. The actual work to complete it takes approximately 3-4 hours, including the creation of our card.

In this way, the second hypothesis (***Hole Clogging in Molds*, Non-uniform Water Removal***) aligns well with my personal thinking. The only problem is I know the root cause now, not then. However, the AI is making an assumption—the correct assumption, among others. Now it is our work to conduct the experiments and initially choose the most suitable route. So AI helped us, but someone at the ***Production Genba*** must do the job. Thus, AI is only a QA expert colleague; the final decision remains ours. So, acting is our issue.

Can we remove some steps, like the Ishikawa classification?... I think it is now an irrelevant classification for the AI work, so we can probably simplify the steps and the information provided.

But please, consider that we are always in control and the final responsible. The AI will not apologize if mistaken, and, above all, the point is: "Give to your AI colleague as much information and context as possible." So, you are in command!

Solo-KJ-Method" and how to be creative

It is not easy being creative, yes! …Do you need a lot of concentration and focus for a long time? …Yes and not? …Nowadays, with all the distractions around us, making it a significant mental effort, it is possible to be creative. So please silence and put away your smartphone in the innovative working environment for a while.

Design Thinking - Practical Introduction in the Internet Archive by Eduardo L. Garcia

The solo-KJ-Method and the Design-Thinking[12] process are very similar; both try to create ideas based on the information we already have. The solo-KJ-method can also be used to gather creative, new, and "stupid" ideas to initiate the creativity effort in the Design-Thinking process. So, the same technique can be used for many different proposals.

The temptation to ask our AI colleague prematurely is always there. But **if we ask prematurely, we will get general, the same, or even useless answers, at least** for now. So, giving the context seems necessary.

We are lazy by nature, and the cognitive effort requires considerable energy. But we need to resist this temptation for a while, just because the AI requires an honest and accurate context to give you the best possible answers. Even our AI colleague needs a context to help us be more creative.

The creative process is straightforward: work and then step away. Repeat this cycle—work and step away—over and over. Keep doing this until you achieve the desired result. Spending more time on the same attempt doesn't necessarily improve the outcome. Sometimes, you even need to destroy all your work and start fresh. This kind of destructive approach is quite

[12] Design Thinking - Practical Introduction, by Eduardo L. Garcia: https://archive.org/details/design-thinking-practical-introduction

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common in creative writing. So, when you have a draft of your story, destroy it and begin again. Don't just correct it; eliminate it and start anew.

1. **Blank paper syndrome**

   What is the key? … an easy start is to write your own cards as soon as possible. One after another, with no excuses: START NOW! And CONTINUE LATER! Whether you can use real cards, Post-its, or even virtual ones in a presentation or even in a dedicated software tool.

   The blank paper syndrome is always present, but can be overcome with a small step forward. And, even if you cannot make more than two or three cards, it is a good starting point to think about your problem and the information you need to create more cards.

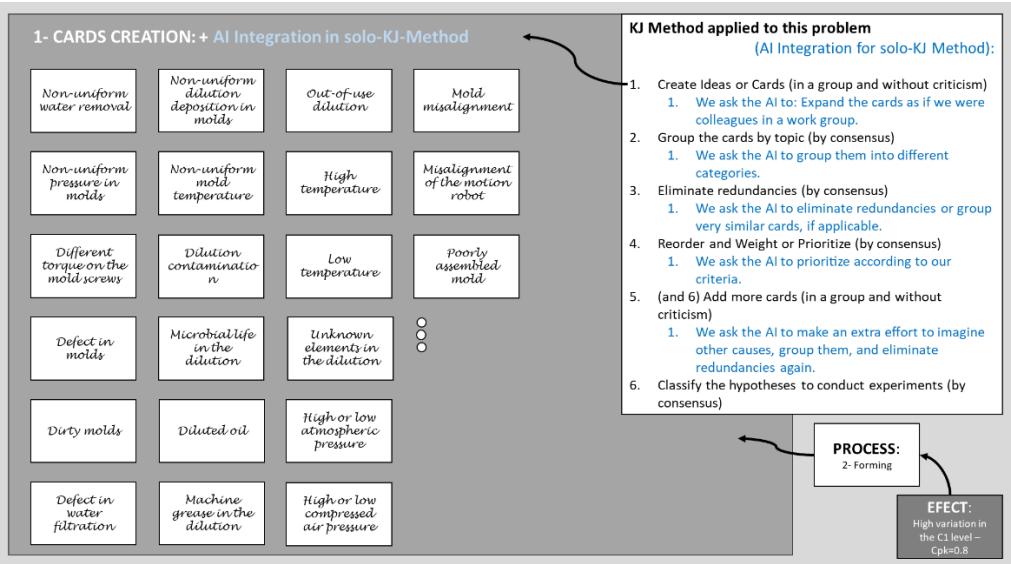
2. **Genba and Serendipity**

   Then, take a break, or do something else, or even walk lazily. Serendipity, as ***Kimura Sensei*** mentioned, is a relevant concept for fostering this kind of innovative effort.

   Return to the ***Genba*** after reflecting to observe the real process, if possible, to better understand your cards and the real process.

   Map the straightforward process*, the constraints, the standard limits, the interactions, and the I/O, the MSA, etc. To understand the process better and give the AI the best information possible. The best format I tested for the AI to understand the process is the scheme formatting: 1, 1.2, 1.2, 1.2.1, etc., as attached on the next page.

   Check your **KJ-Method Cards, run your process**, and describe them better if you could not do so at the beginning. Thus, going back and forth repeatedly.



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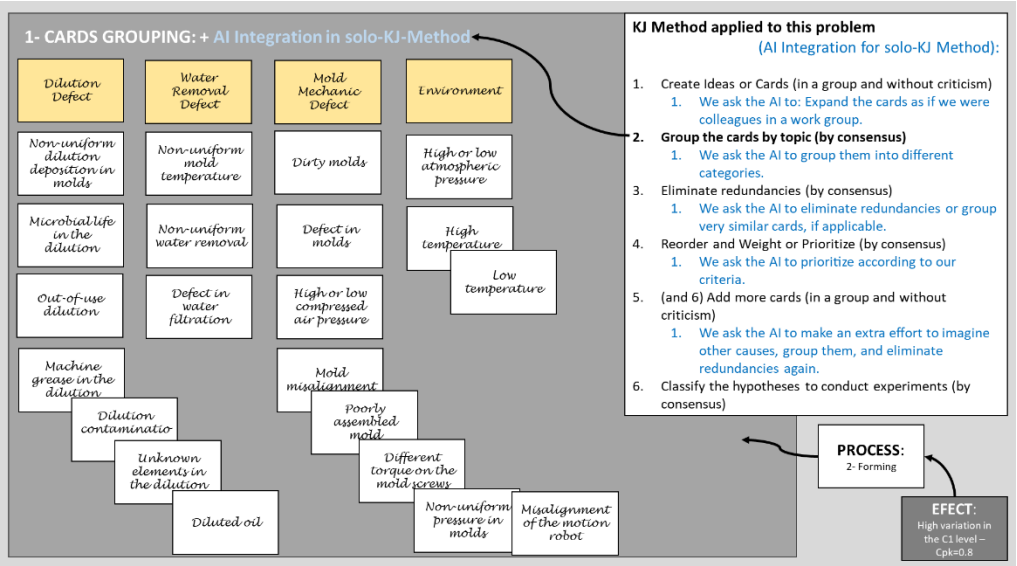
3. +24H

Then, after 24 hours and after sleeping well, make another focused effort to produce more cards and update the ones you already created.

Repeat the process until you get almost twelve or fifteen cards. Even repeated cards are suitable. And, even similar content is a valid card. Moreover, using different names but the same or similar content is also an effective card that leads to new ways of thinking.

Stop and start again if you cannot get more ideas, and repeat the process after +24H.

When you have enough cards, you need to make another effort to group them into the categories you consider. This is a step you can ask the AI, as well.



*Industrial process and flow map**

The industrial process includes the following steps. It is a chemical process involving water dilution, carried out in two parallel lines: L1 and L2: The final product is the paper-based cup.

1. ***Preparation: Dilution of the mixture (common to L1 and L2):*** *Paper paste. The dilution is similar to that of other paper industries, and the process is also very similar. Refining is part of the industrial process. Once refining is complete, the dilution is deposited in some big tanks till the next dilution batch is required. The mean temperature of the process depends on the external temperature and varies from 15 to 25 degrees Celsius. The Preparation and the next step (Forming) are separated by 50 meters. The dilution is warmed slowly to the final by the tubes and the Forming Machine.*
2. ***Forming L1 and Forming L2.***
    1. ***Shaping the shape*** *by filtering the dilution into the moulds by vacuum and deposition in over-moulds was also helped by gravity. The water is not thermos-controlled, and the temperature depends on the controlled environment; the dilution remains relatively stable from 30 to 40 degrees Celsius. The moulds are 9 cavities, and we have 9 moulds per step.*

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The temperature of the moulds is usually 50-60 degrees Celsius. We have some microorganisms living in the dilution, which is why we clean up the machinery once every 72 hours of operation.

2. ***Pressing 1**. Removing the water step 1. By pressure, we remove the water mainly by vaporization. So, the mould has some holes to absorb the water. The parts are moved to another mould by an anthropomorphic robot in 9 sets, and we follow step 2.3 to remove 100% of the water.*
3. ***Pressing 2.** Removing 100% of the water in step 2. Then the 9 sets of 9 cavities are subjected to gravity during the visual inspection phase.*

3. ***Transport/Conveyance** and preparation for post-processing*
   1. *Initial process: Transport, manual sorting, and acclimatization. Acclimatization is not described for now because it is irrelevant for the problem studied now.*
   2. *Automated process after four months: Transport and acclimatization.*
4. ***Post-processing L1 and L2***
   1. *Rough cut from 9 cavity parts to one cavity part.*
   2. *Calibration for the ring where the nails get into the cup in the Nespresso machine*
   3. *Lamination (warm plasticisation into the cup) by vacuum*
   4. *Final cut*
   5. *Artificial vision validation: Online validation by artificial vision. This artificial vision is providing us with a lot of information, mainly about the Lamination process.*
5. ***Visual inspection and Packaging***

4. Consolidate

Grouping, removing duplicate cards, and consolidating the gathered information into a document.

For our AI colleague, we need to gather all previous information and additional details regarding the quality process and the detected problem. **All of the information collected in the same document is uploaded just before making the prompt**.

Making islands with the cards or grouping is the key to organizing our available information. The Ishikawa (5M+E) categories are suitable for solving problems, but organizing a theme requires more creativity and a profound knowledge of the process you are analyzing. Thus, creating islands and Lands (groups of Islands) is part of the consolidation process. The cards can be gathered vertically, as you might with Post-its.

Please take a look at the TQM-5[13] to delve deeper into the KJ Method as explained by Kimura ***Sensei***.

TQM-5 The KJ-Method

Now you can create a **flow map***, for instance, to link the islands and describe your process. It can be used not only to identify potential

[13] TQM-5 KJ-Method: https://archive.org/details/tqm-5-the-kj-method

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problems but also to generate new “stupid” ideas or even to map a process or project.

We will come back to this Consolidation process in the following lecture. Just because it is also used in the Matrix Diagram described in the previous lecture by Kimura ***Sensei***, when he grouped all the information regarding a problem or a process in the same matrix graph.

5. +24H

Try to refine your consolidation document after 24 hours and **re-check your KJ-Method process and steps**.

Eduardo L. Garcia

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